A HANDBOOK FOR WILDERNESS SURVIVAL

Bob Harris

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If you pursue any form of outdoor recreation for any length of time in primitive surroundings, you are likely to become lost or stranded at some time. What stands between you and ultimate disaster is a knowledge of the basic elements of survival, your common sense, and your own ingenuity.

Nature is never hostile, only indifferent. Odds are that you will not be torn apart by wild animals, you will not starve to death, you will not freeze to death, and you will not suffer undue hardship unless you are both careless and stupid.

Life's necessities are all around you, but they are not prepackaged with detailed, useful instructions. A *Handbook for Wilderness Survival* provides the how-to manual to tip the scales toward life in any survival situation. The single biggest threat is fear itself and all such fears are baseless.

A *Handbook for Wilderness Survival* tells you how, in any situation, you can:

(continued on the back flap)

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For Mary,

who taught me what

a mother should be.

Contents

Preface

It makes no difference what your preferred form of outdoor recreation is: if you pursue it long enough in primitive surroundings, you are likely to become lost or stranded at some time. In many such situations, only a knowledge of the basic elements of survival, your ingenuity, and your own common sense would then stand between you and the ultimate disaster.

Do not then allow yourself to think that you are facing a hostile environment or that the weather is trying to do you in. Nature is never hostile, only indifferent. Whether you live or die makes no real difference in the scheme of things, and you will neither be helped nor hindered in your struggle to survive. The wind will blow at the same speed and the temperature will be exactly the same whether you are adequately sheltered and clothed or completely exposed, and snow will fall as gently or as softly on your frozen body as upon your snug and cozy shelter.

Of the many dangers that may seem to threaten, most are either groundless or grossly exaggerated. You will not be attacked by wild animals, with the exception of biting and stinging insects. Rattlesnakes are a minor hazard in some areas and at some times, but will avoid you if they can. Black

bears may raid your camp, but are normally no threat to you. None of these are present in winter. The single biggest threat is always fear itself, and most such fears are baseless.

You will not starve to death, you will not freeze to death, and you will not suffer undue hardship unless you are both careless and stupid. Regardless of what the coroner may choose to list as the cause of death when a stranded or lost adult is found dead, the actual cause is ignorance or carelessness.

The necessities of life will be everywhere around you, but they are not there for your benefit. They are not packaged and labeled for your convenience, and no sheet of instructions comes with them. You will have to find and procure what you need by your own unaided effort, and you must adapt it to your use on the basis of your own knowledge.

The information contained in this book should enable you to survive almost any situation in the wild, but it should be used primarily as a guide in seeking firsthand information on your own. The book will tell you much of what you need to know, but any additional knowledge will be invaluable in a survival situation.

To gain full value from the instructions contained herein, test each one before your life becomes dependent upon it. Try to build a fire by each of the primitive methods outlined in Chapter VII. Make the attempt in vile weather, but in your own backyard, so you can retreat to the safety of your home when the attempt fails. Once you have learned for yourself how difficult and uncertain such methods are, you will be doubly sure to equip yourself with a more dependable means of starting fire when you again venture afield.

Make each and every trip into the field an imaginary survival test. Learn to identify the plants you might someday need and gather some of them to be sampled as food. Set up

an emergency camp, perhaps only a few feet from your comfortable camper, tent, or trailer, and spend a night in it. You will then probably be able to think of additional ways to ensure a reasonable degree of comfort if forced to remain out overnight.

Practice using a map and compass, even if you are in country you know well. Practice the other means of determining direction, too, and learn to identify the North Star at a glance. Practice making snares, deadfalls, and traps, using sticks as "animals" in any devices that would injure or kill. Learn to identify the tracks, droppings, and other signs left by birds and animals and study their habits.

Remember always that under that pampered, scrubbed, comfort-loving exterior, you are the exact counterpart of the first members of our species, and you have inherited each and every one of the instincts and abilities that have brought that species to dominion over the earth. You are also the rightful heir to the accumulated knowledge of many cultures over many centuries.

Under that sleek and helpless-appearing surface, then, lies the toughest and most adaptable animal this world has yet known. Your ability to survive in a desperate situation depends to a large degree upon how quickly and completely you can shed that surface veneer of culture and revert back to the omnivorous, opportunistic, no-holds-barred ways of your remote forebears.

Your life is important only to you in a survival situation, and you alone will decide by the actions you take whether you will live or die. This book is intended to help you tip the scales toward life. Good luck!

Chapter I

If You Are Lost

Your first reaction when you suddenly realize that you are lost is apt to be blind, unreasoning panic. You will have an almost irresistible urge to run, as if mere speed would get you out, even though you haven't the faintest idea where "out" is. Searchers have often found the bodies of lost persons who have run themselves to exhaustion and death or have run blindly off cliffs or into disabling or bone-breaking obstacles in this first panicked rush.

When you first become aware that you are at a complete loss as to direction or location (this awareness strikes suddenly and without warning), stop! Clear a space of flammable material and build a fire. Make a cup of cocoa, coffee, tea, or plain hot water if you are equipped to do so. Light up a pipe or cigarette if you smoke. The human mind is so conditioned that a fire means security, and panic is unlikely to persist in the light of a cheerful blaze. The hot drink will give you a lift and the pipe or cigarette will add to your sense of well-being. Reason will return, and you can assess the situation calmly and rationally.

When you first realize that you are lost, you are usually not very far from a known point. Draw a sketch map in the bare soil near your fire. Sketch in visible topographical features and mark your present location in relation to them. Try to trace in the route you took in getting here. You can often determine where you took the wrong fork in the trail, followed the wrong ridge, or crossed one too many draws.

You should pinpoint on your map the last point where you definitely knew where you were. You will find, in most cases, that you are fairly close to that spot and can remember your way back to it. Alternatively, you may be able to recognize some feature of the visible landscape as a known landmark seen from a different angle.

Unless you reestablish your orientation to the point that you are positive you know where your car or camp is, and unless you are reasonably sure that you can reach it before dark, make an overnight camp and settle down to wait for morning. If you are merely "mislaid" and the weather is mild, your problems will be solved with the return of daylight, especially in well-roaded country. In any case, once you are camped you can make your decisions calmly and sensibly, basing them on your reasoned assessment of the situation that confronts you.

Never allow yourself to be influenced in your decisions by the need to keep others from worrying. Your life is more important than anyone's peace of mind. Don't fret about being late for work or missing an appointment, no matter how important that job or appointment might normally be. Don't worry about the hazing or ridicule you may later face from your hunting or fishing buddies or the nicknames of "Old Pathfinder," "Dan'l Boone," "Davy Crockett," or such that they may call you. To survive is the only imperative, and all decisions must be made with that one objective in mind. All else is trivia.

If, once you have settled down, you think you can find your way back to a known point, *be very sure to mark your present location before setting out to see if you are right!* Remember, this spot is at least fairly close to a known point. Tie a piece of brightly-colored material to a tree or stake, build a conspicuous tripod or a cairn of stones, or simply bank the fire (in damp or wet weather, but not in

fire season!) with long-lasting materials that will make it smoke profusely. Mark your trail as you leave this point by breaking brush or branch tips, by leaning poles against trees, or by setting stakes or piling stones as markers. You can then return to your fire if your new-found sense of direction should prove to be misplaced, and can set up an overnight camp nearby.

If in really wild country or if the weather is severe, and you can't decide with reasonable certainty where you are in relation to some reachable objective, stay where you are! Don't compound your problems by striking out blindly. You will exhaust your energy to no purpose if you allow yourself to blunder about with no real idea of where you are going. You may also leave the search area of possible rescue parties. These people will be better equipped both in knowledge of the area and in actual equipment than you are, so let them do the moving while you remain in one place to give them a stationary target.

Help such searchers by building a smudge fire if weather conditions are such that smoke can be seen from a distance. Green boughs or damp leaves thrown on a hot fire or on a bed of live coals will produce a dense white smoke. Motor oil, animal dung, or pitchy wood will produce darker smoke. The white smoke is hard to distinguish from rising wisps of fog or against low, light-colored clouds, but is otherwise highly visible. Keep a good supply of smoke-producing materials near the fire, ready to be tossed on if a plane passes over.

Aim the beam of a flashlight or sunlight reflected by a mirror at passing planes (a polished piece of tin or an unwrinkled piece of tinfoil will serve as a makeshift mirror) or sweep the horizon with random but more or less regularly-timed flashes. Such a heliograph flash is visible and eye-catching from miles away and will hold the attention of

anyone who sees it. If that person knows, or later learns, that someone is lost in the area, he will either investigate its source himself or report it to someone who will.

Spell out *SOS* or *HELP* by spreading ashes from a fire, by sweeping the letters free of snow, or by laying green boughs or other dark-colored material in a snowy clearing. Such messages must be as large as you can reasonably make them, with letters five feet thick and twenty-five feet tall being the bare minimum and twenty by one hundred feet being much better. You can make contrasting lines in any area of more or less uniform coloration, such as a sandy beach or dune, an alkali flat, a meadow clothed with either green or dry grass, or a bare hillside. Make the lines by stacking vegetation, by wetting or disturbing the soil, by tearing up the grass to expose the dark soil beneath, or by controlled burning of vegetation. The more marked the difference in color between message and background, the more easily it will be seen from the air.

Shadows are easily seen from a plane, and letters stamped or dug into deep snow will show up black from above whenever the sun is at a sharp angle to the depressed letters. Even a thin screen of any opaque material or a raised bank of snow along the sunward side of a letter will cast visible shadows. If the sun is not shining brightly enough to cast dark shadows, then you must use dark-colored materials to make the letters visible.

An emergency code of signals designed to facilitate ground-to-air communication is simple, easy to learn, and well worth knowing. The code is most widely understood and works best in areas where pilots are most familiar with search and rescue, but these are the very areas where an emergency calling for such knowledge is most likely to occur.

If you are injured or sick and in need of medical assistance including a doctor, make a cross or a single straight line. If

you need medical supplies only, make two parallel straight lines. Make a capital *F* to ask for food and water, and a simple square to ask for map and compass. (See Figure 1.)

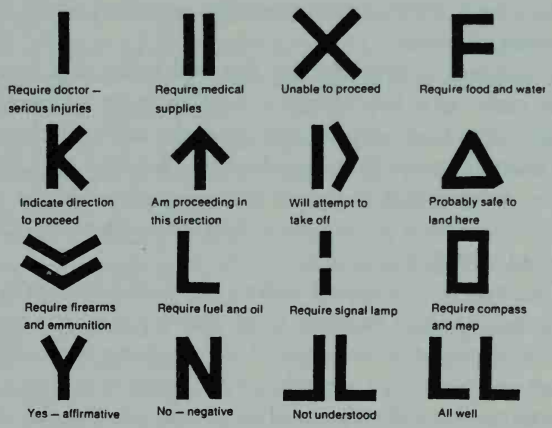

Figure 1: Emergency signal code

When a pilot has spotted your distress signal, he will generally circle closer, either to observe you or to direct ground parties to your location. This is the proper time to use your body as a signalling device. Lying flat on your back with arms stretched out to the sides means you are injured or sick, as does standing with your arms crossed in front of your body so that the right palm is in front of the left hip and vice versa. Standing with arms stretched over your head means you want to be picked up. If you don't remember these standardized signals, simply kneel and assume an attitude of prayer. This will be instantly recognized by anyone as a plea for help; and in this day of the helicopter, help will arrive in a short time.

Three fires in a row, three equally-spaced puffs of smoke, three spaced blasts on a whistle, three shots fired in a timed sequence—all are universally recognized as distress signals. If in hunting season, the shots should be fired shortly after full dark to prevent their being mistaken for ordinary hunting shots. Don't waste ammunition by repeating often, unless you hear answers.

In summer, a large smudge fire will bring help in a very short time, as a fire watch is kept in most timbered and brushy areas then; anyone seeing smoke will quickly report it. You must make sure that the fire is built in such fashion and so located that it cannot possibly spread. If the site is timbered or brushy, you must be alert to the risk of being bombed with fire retardant.

You owe it to yourself and to the public to take certain precautions before entering areas where you might conceivably become lost or stranded. Always inform someone as to where you plan to go and when you intend to return, so that a search can be made if you fail to turn up. Ideally, this should be a relative or friend who will be concerned enough to take action when you are overdue. It must not be another hunter or other person casually encountered, as he has no personal interest in your welfare and may forget or move on before your scheduled return. If no suitable person is available, leave a large note in your car, weighting it in such a position that it can be read from outside the car. Spell out exactly where you have gone, when you plan to return, and add any other details you think pertinent. This might result in thefts from your car, but it might also result in saving your life!

Once you have told others where you will be, *do not go elsewhere without notifying them of the change in plan, and don't fail to let them know when you return!* Both mistakes are frequently made, and they sometimes result in a full-scale search being made for no reason or in the wrong area.

Many persons have been lost, some of them fatally so, when they spotted game while puttering around in camp, snatched up bows or rifles, and ran in pursuit. A similar situation often occurs when game is seen from a car. The hunter quickly parks the vehicle, grabs his weapon, and takes off after the quarry. Under either circumstance, the hunter is likely to be poorly prepared, often being hatless, coatless, or without gloves. He rarely has matches or a lighter unless he smokes, and has none of the other items necessary if he is to spend a night in the woods in relative comfort and safety. Incidents such as this tend to occur late in the day, and, if the weather is severe, the hunter is headed for a night of misery at best, and possibly for death.

Carry an emergency kit at all times when afield, and make this so much a part of your gear that you feel naked without it. The best-planned and most efficient emergency kit is totally worthless when left in camp or car, so make it an unvarying habit to carry it at all times. When you arrive in camp or get into a car, fasten the kit to your bow, rifle, or fishing rod so you cannot take one without the other. *Never be caught without an emergency kit!*

Chapter II

Emergency Kit

An emergency kit to be carried on the person should be totally waterproof, unsinkable, and rip resistant. It should contain waterproof matches in a waterproof container with a self-contained striker; tinder; aluminum foil; fishhooks and fishline; a coil of light, strong wire such as brass or copper picture-hanging wire; a large square of transparent plastic film; a magnifying glass; a spare compass; a double-face signal mirror; and a police-type whistle for emergency signaling. (A whistle's blast can be heard several times as far as the loudest shout; blowing one consumes far less energy than shouting, and the sound cannot be confused with any of the normal background noises.)

If you need corrective glasses, place a second set in its own protective case in the kit. In winter, carry snow goggles or polarized sunglasses with close-fitting side shields and add extra "fire insurance" in the form of a butane-fueled lighter. In summer, add iodized salt tablets, insect repellent and a face net, and a snakebite kit.

Include a first aid kit containing tincture of iodine, bandages, tweezers, a soothing eye ointment, headache pills, a mild laxative, and three feet of surgical rubber tubing. (This can be used as a tourniquet, but it is useful in many non-medical ways as well.)

The kit should contain some means of boiling water, as many foods that you could not otherwise use are made edible or palatable by boiling. Drinking heated liquid will

restore deep body heat faster than any other method. Pack the smaller items in an army canteen cup, which can also do duty as a kettle. Add several plastic bags of the type used for boiling or roasting. These take up little room and weigh almost nothing, yet they will work as boiling kettles if the flames are kept from touching them above the water level.

Although you will probably have either a sheath knife on your belt or a pocketknife in your pocket, you should also put a good-quality Boy Scout knife, a Swiss Army knife, or a "Leatherman Tool" in the kit. These have a number of useful tools in addition to their cutting blades. A pair of four-inch vise-grip pliers is almost indispensable, as is one of the compact knife, fork, and spoon sets designed for campers.

One item that should always be included, especially when cold or wet weather is a possibility, is one or more of the tiny "space blankets" that weigh only two ounces. These are folded to be only slightly larger than a cigarette package when purchased (like a road map, it is hard to refold one to that size!) and are made of a super-reflective material that will reflect more than 90 percent of incident heat. This is a poor substitute for a regular blanket, but it will serve as a splendid shelter top or liner, a water catcher when it rains, a windbreak, an emergency poncho, liners for wet boots, or a radar-reflecting signal.

Another almost indispensable item is a small flashlight of some kind. Even a penlight is a great deal better than nothing. To be on the safe side, put a snippet of tape between the battery and bulb to prevent an accidental discharge of the batteries. It is also good practice to have an extra set of alkaline batteries and a spare bulb.

This list sounds formidable, but all items listed can be contained in a package not more than six inches in any dimension; and the pack when filled will weigh less than two pounds. If an emergency ever arises when you need its con-

tents, you will agree that it is worth more than its weight in diamonds!

A much larger list of equipment can be carried in a small backpack, since the bulk can be considerably increased and the weight can be raised to five or even ten pounds without a problem. The cooking gear can then be increased by the addition of an aluminum mess kit, a nested set of backpack kettles, a small roll of aluminum foil, and perhaps a cooking grid. The tiny space blankets can then be supplemented by one of the twelve-ounce space blankets, which are actually useful as blankets and are so brightly colored that they are also useful as signal devices. These are very valuable as emergency equipment. Don't substitute this for the smaller type; carry both. Both are useful, and two ounces is too little weight to be of concern.

When traveling in cold weather, you should carry a two-pound down sleeping bag (as a minimum) or its equivalent, as well as an extra suit of down or fiber-filled underwear. When used as pajamas, these add the equivalent of several pounds to your sleeping bag; and when worn under the outer clothing, they nearly "cold-proof" your body. You should then also carry an extra set of mittens or gloves, at least two pairs of heavy wool or thermal socks, an extra set of felt liners if you are wearing packs, and a knitted wool cap or balaclava helmet. Worn as a nightcap, one of these again adds considerably to the warmth of the sleeping bag.

In dry country, you will want to carry a sizable canteen in addition to your emergency pack.

A much larger emergency pack should be carried in any vehicle venturing into unpopulated or infrequently traveled areas. Any vehicle can strand you, either through mechanical failure or by becoming stuck. For an auto or plane, the list of items carried should include sleeping bags for all passengers, a small tent, nested cooking gear, at least five gallons

of fresh, potable water (much more if in arid country in summer or if more than two passengers are along), a supply of basic foodstuffs, an axe, a shovel, and a bucket. (The last three items are required by the U.S. Forest Service when a vehicle enters one of the national forests during fire season.)

A boat needs the same basic supplies already packed in a watertight container that is securely fastened to the life raft or dinghy.

Signal flares or rockets should be carried on a boat or plane, and the red signal flares carried in cars and used to warn traffic of stalled vehicle or other hazard can be used to signal aircraft or other potential rescuers as well. They are also useful as emergency fire starters.

One of the most useful items in any emergency pack is a contour or topographical map of the area you are entering. This is especially useful if you are traveling on foot. When traveling by car, you will need a larger map or several maps, as topographical maps do not cover large areas.

The map is most useful, of course, when "square with the world" or properly oriented by compass.

Chapter III

Direction Finding

Carry a good-quality, liquid-filled or mechanically or induction-damped compass attached to your clothing or to a cord around your neck. *Use it to take bearings before leaving known territory!*

You can't use a compass to find a road, a power line, or a stream unless you first know the general trend of its course, and you can't locate your camp by taking bearings on a landmark unless you first know the bearing from the camp to the landmark. *You cannot "follow a compass needle" anywhere!*

To demonstrate this, hold a compass in your hand and let the needle settle on the *N*, but without sighting on an object. Now move well to one side and try the compass again. No matter how far or how often you move, the compass will always find Magnetic North, but the sighting lines will be a series of parallel tracks. They would allow you to travel in a generally northward direction and nothing more! You might be well to the east or west of your original sight line on each successive sighting. You can only follow a bearing to, from, or based on some object or mark.

Such a bearing or azimuth line is unique. If you establish bearings to two separate landmarks, then you have established a unique point. *At no other spot in the universe will those lines intersect!* Given those azimuths and an adequate description of the landmarks, anyone could easily find that exact spot.

You must believe the compass! This seems so basic, so elemental, as to need no stating; but the compass reading often seems so totally at variance with the evidence of your senses that you will be tempted to disregard it, to think the compass defective. Check it with the spare from your kit if you must verify it, keeping the two well away from each other, and from iron or steel or any operating electrical device. A gun barrel, a knife, or even a steel belt buckle will cause a grossly inaccurate reading if the compass is held near them; and a flashlight when turned on is one of the worst culprits. *Lacking such proof, believe the compass, not your senses!* Experience proves that human senses often lie, but a good compass seldom does. When one does, the cause is interference.

The discrepancy caused by iron or steel or by other anomalies is known as "magnetic interference," "magnetic deviation," or "magnetic deflection." To check whether or not some part of your clothing or equipment is deflecting the needle and giving a false reading, place the compass face up on a level surface and slowly back away from it. If the needle moves as you move toward or away from it, something on your person is the cause of the movement. There is no certain field test for magnetic ore deposits or other such anomalies, however. Remember that an electric watch, the light meter of a camera, a flashlight bulb, or any other electrical device creates a magnetic field when energized, and the compass needle will react. A nearby power line will render a compass unusable. The magnetized needle of a spare compass will also cause a grossly inaccurate reading when the two compasses are in close proximity.

To use a compass with confidence, you must understand that the needle is magnetized and will therefore be attracted by ("point to") any magnet of opposite polarity or will align itself with the lines of force when in a magnetic field. In real-

ity, then, the magnetized needle of the compass aligns itself with the magnetic field of the earth, and the north-seeking end of that needle (actually its own southern pole) is said to "point" to the magnetic north pole of the earth. A magnetized sewing needle thrust through a cork and floated in a bowl of water will act as a primitive compass. Any magnetic compass is merely an updated and improved version of this, and with the cheap, snap-top, pocketwatch types of compasses, the only improvement is their portability. Just as with the cork and needle, they will indicate Magnetic North in a general sense, but offer little other useful information. They are notoriously undependable.

Because the magnetic pole is actually a 50-mile-wide area located at approximately 75 degrees north latitude and 100 degrees west longitude, and because the Geographic North Pole is at 90 degrees north latitude and is common to all longitudes, compass needles do not "point" to or indicate True North. The needle can automatically point to True North on only one line, called "the agonic or no-angle line." This line enters the United States in the Great Lakes area, cuts through Lake Michigan, runs down to Florida, then out to sea. This line (and the whole magnetic field of the earth) shifts westward by seven minutes of longitude per year.

As you move away from this line, a discrepancy develops between a true north-south line and a magnetic north-south line. The amount of this discrepancy, known as "magnetic declination," increases rapidly with distance and even more rapidly as one moves north. As you will note on the isogonic chart shown in Figure 2 (on the next page), the declination varies widely and without apparent reason. The isogonic lines are numbered outward from the agonic or zero line and are represented by a number and a letter. The number indicates the degree of declination, and the letter indicates whether it is to the east or west. The compass nee-

dle does not lie along the line, which merely connects all points having a common degree of declination. ("Isogonic" means equal angle, see Figure 2.)

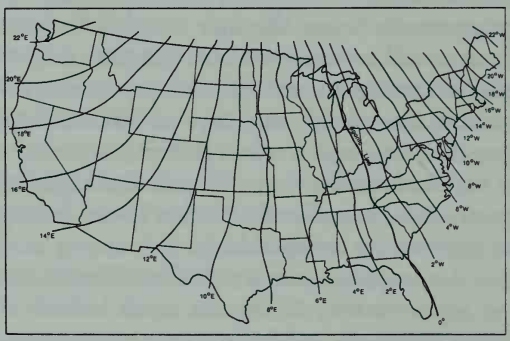

Figure 2: Isogonic chart

The amount of declination is usually marked on maps. Most maps have a small triangle drawn to represent true north-south and magnetic north-south lines. The lines are marked *TN* (although the letters are often replaced with a star) for True North, *GN* for Grid North, and *MN* for Magnetic North. You can safely ignore the Grid North line, but you must take the declination into account when trying to establish bearings. It is often said that you subtract (from the compass reading) for west declination and add for east, *but this is true only on a dial numbered in a clockwise fashion.* The Cruiser- and Forester-type compasses are numbered counterclockwise, and some compasses have both clockwise and counterclockwise numbering. The simplest way is just to remember that anywhere west of the agonic line (in most of the continent, therefore), Magnetic North lies to the east of True North. Remember the westward drift of seven minutes per year. If the map is dated, multiply the number of

years since it was printed by seven minutes to get a correct declination figure. (See the next chapter for information on longitude.)

If you have no map, you can determine the degree of declination for your area whenever you can see the North Star, Polaris. Sight over two sharpened stakes, moving one as necessary to get them in proper alignment. The stakes must be needle-pointed and you must sight with your dominant eye, just as you would with a rifle. When so aligned, the stakes represent a true north-south line; and your compass will give you a magnetic north-south line. The difference in degrees between these two bearings is the declination for that area.

Magnetic declination reaches a value of 150 degrees and higher in the far north, and each degree represents a variance of more than one hundred feet per mile of travel! The computation is simple: Forty-five degrees of deflection would equal one foot of deflection for every foot of forward progress. Five thousand, two hundred and eighty divided by forty five yields well over one hundred feet per degree. You cannot afford to ignore this factor when traveling by map. You can safely ignore it, however, when you have taken a bearing on a visible objective.

Compasses come in many styles and price ranges, but the best one for ordinary use, in my opinion, is the Cruiser or Forester style. In this type, usually rather expensive, the degrees are marked counterclockwise, with the letters *E* and *W* transposed. This allows the "North" end of the needle to point directly at the proper azimuth number. To go due east, for example, simply turn the compass until the "North" end of the needle points at the *E* or 90 degrees. The sighting line will then point directly east. Declination for the area can be preset with an adjustment screw.

Another feature of this and other good-quality, mechanically or induction-damped compasses is a number of turns of

fine copper or brass wire on one end of the needle. This feature is an adjustment for "magnetic inclination" or "magnetic dip." The wire winding is slid inward or outward to compensate for the tendency of the needle to dip toward the earth when near the magnetic poles. This feature is not found on liquid-damped compasses, as you could not gain access to the needle.

The Swedish Orienteering Compass is another good choice for the nonprofessional user. This consists of a rectangular plate of transparent plastic, often with one long and one short edge ruled for use as a ruler. The narrow ruled end is usually beveled as well, and the unruled end normally has a hole for the attachment of a lanyard or cord. An engraved and painted "way-to-go" arrow, sometimes interrupted by a small magnifying bubble, leads from the raised housing to the center of the narrow ruled end. These configurations vary slightly in different brands, but the basic elements remain the same.

Around the top of the housing, or on an internal or external flange on some models, is a circle divided into 360 degrees numbered clockwise and divided into quarters by the letters *N-E-S-W.* Intermediate directions are normally indicated by dots called "ticks." The housing is so mounted that it is free to rotate on the base plate, but will remain fixed until some pressure is exerted to turn it. Its top is transparent so you can see both the needle (this is contained in an oil bath to prevent or "damp" excessive vibration) and a broad arrow engraved or painted on the housing floor. The tip of this arrow points at the *N* mark and turns with it.

Let us suppose you want to travel due east. Simply hold the base plate firmly and rotate the housing until the base of the way-to-go arrow is at *E* or 90 degrees, plus or minus the declination allowance for the area, then rotate your body

until the compass needle and the arrow beneath it are perfectly aligned. The way-to-go arrow will then point due east. To reverse your course exactly, rotate the housing 180 degrees so the way-to-go arrow is at the *W* or 270 degrees, plus or minus the allowance.

Always remember that it is physically impossible to "follow a compass needle" anywhere! You must take a sighting on some object to establish a bearing. Then, as long as you can see that object, you can hold to that bearing or return to it if forced to detour. If the object will be obscured during part of your travel, you must establish a line of intermediate targets and proceed from one to another. Remember that a reverse or reciprocal bearing is just as useful as a forward one, as you can travel as directly away from a bearing point as toward one. To determine the proper back bearing so that you can retrace your course, simply point one end of the compass needle (either end) at your original azimuth. The other end will then point at the reciprocal bearing. You can also figure this by adding or subtracting 180 to or from the bearing, adding if the bearing is less than 180, subtracting if it is more. If you wind up with impossible figures such as more than 360 or less than one, you added when you should have subtracted or vice versa.

It is good practice when in strange country to take cross bearings from prominent landmarks to your camp or to a salient point near it. Do not try to commit these to memory; write them down. As long as one of those landmarks is visible and recognizable, you can always locate your camp. If you can see two such points, the task is easy. At no other spot in the universe will those two bearings from those two landmarks intersect.

It is almost impossible to go away from and return directly to a single spot, such as a car or camp; but it is easy to return to a baseline such as a road, a power line, or a stream.

The problem often is to know which way to turn once you reach the baseline. The easiest way to solve this problem is to deliberately bear to one side of your original course when returning, with the outward and inward courses forming a definite **V**. The amount of deliberate error should be determined by the distance to be traveled. Remember the formula: one degree equals one hundred feet per mile. For the **V** to be wide enough to be useful, you must veer off from the reciprocal bearing by ten or more degrees for short distances, much smaller amounts for long distances. When you reach the baseline, you then know which way to turn.

A map must be "square with the world" to be very useful. To properly orient a map, you must turn it so that the north-south lines on it are in alignment with the north-south axis of the earth. You can most easily do this by aligning your compass needle with the magnetic north-south line on the map if this is indicated. If it isn't, you must place the compass on the map with the *N* and *S* on one of the north-south map lines, then rotate the map until the compass needle points to the proper azimuth to allow for declination.

You can use a watch as a compass if the sun is bright enough to cast a shadow and if the watch is properly set for the time zone. Remember to allow one hour for daylight savings time. Point the hour hand at the sun while holding the watch face up. Due south then lies at the point midway of the shortest route between the hour hand and noon (1:00 P.M. DST). If it is before 6:00 A.M. or after 6:00 P.M., you must use 6:00 instead of noon. A digital watch is useless for this purpose. (See Figure 3.)

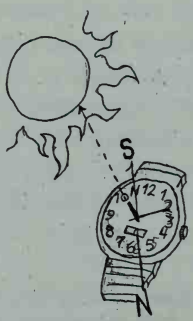

Figure 3:
Watch as compass

Even on thinly overcast days, it is often possible to locate the sun by standing a twig on a watch face, a mirror, or a spectacle lens. Such a polished surface tends to reflect even faint light, and the twig will cast a faint shadow directly opposite to the position of the sun.

The North Star, Polaris, actually rotates around a circle two degrees in diameter, so is exactly in line with True North at two points of this circle, but is never more than one degree from it. Polaris is directly overhead or at ninety degrees to the surface at the North Pole and is just on the northern horizon or at near zero degrees near the equator. The degree of angle to the ground is thus the exact latitude at any point north of the equator. Polaris can be most easily found by drawing an imaginary line from the bottom of the Big Dipper, *Ursa Major,* outward through the two stars that form its pouring lip. The first bright star just off this line is the North Star. It actually is the last star in the handle of the Little Dipper, *Ursa Minor.* (See Figure 4.)

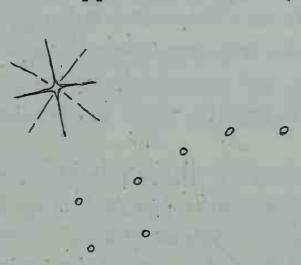

Figure 4: North Star

If you cannot see the North Star, you can determine direction by observing any other star or star pattern for a period of time. Locate the star or star group in relation to some fixed reference point such as the tip of a tree (if the wind is blowing, use a sharpened stake instead of a tree) or between two reference points. If the stars seem to be rising, you are facing east; if they are sinking, you are looking west. When you are facing north, stars will appear to be moving from your right to your left; and stars moving from left to right indicate you are facing south. The movement is slow, but it is easily seen over a period of half an hour.

Most of us have no trouble in knowing which direction is which in a general sense whenever the sun is shining. If a general idea of direction is not enough, however, as when you want to orient a map or reset a watch, you can use the shadow method. This was the original principle that allowed for the construction of sun dials. There are several variants, but the most accurate, easy-to-use, and least time-consuming of all is the shadow stake method. It has become the standard technique described and recommended in all U.S. military survival manuals. It will enable you to determine direction with a plus or minus error of less than five degrees.

Drive a tall stake into the ground and mark where the shadow of its tip strikes the ground. Wait ten minutes or so, then mark the new spot where the shadow of the tip strikes. A line drawn through these two points is a true east-west line. To determine time, simply draw a short line at right angles to the east-west line and plant a stake at the junction. You can use this stick as one point of a compass (dividers), using a stick on a string to inscribe a circle that will represent a twenty-four hour clock. In any case, when the shadow of the stake is parallel with and completely covers the short northward side line, it is exactly noon in standard time.

Do not attempt to tell direction by which side of a tree has the most moss, by the relative width of growth rings in tree stumps, by watching so-called "compass plants," or by noting which way trees have fallen. All are subject to so many variables that any reliance on them is foolish.

When you read such instructions on route or direction finding, you should check them out by trying to make them work when you are not under the pressure of really needing them, and when no life is at stake when they fail. You will find that such systems are undependable at best and are totally unworkable in most instances.

Do not, in any circumstance, depend upon "a sense of direction!" The U.S. army has proved, by repeated experiments, that no such sense exists in human beings. When blindfolded, all persons tended to walk in circles; and the same was true of persons tested in a dense fog, "whiteouts," or snowstorms where visibility was sharply restricted.

Both sides of a mountain often look the same when visibility is limited, and you might easily find yourself in the wrong watershed. A blanket of snow will make familiar country look completely strange, and people have been known to cross good roads, paved highways, or frozen streams (in level country) on fresh, untracked snow without realizing they had done so. They may then have based their plans on knowing the road or stream was safely reachable in front of them when it was, in fact, already behind them. Such misunderstandings have often led to tragedy.

Always carry a compass, no matter how well you know the country and even if you are fully confident of your ability to navigate!

Being lost is the result of not knowing your own location, the lay of the country, or the direction to go to reach your destination. You can solve each of these problems with a map.

Chapter IV

Maps

The first maps were probably lines sketched with a stick in the soil or sand and were undoubtedly accompanied by verbal instructions to "go down the creek until you reach the big rock, turn right up the hill to the big pine, turn left there—," or something to that effect. This is still used extensively and works very well when both the mapper and his listener are familiar with the area.

When man began to leave his home territory, it became necessary for him to make more complicated maps, and these became more complicated still when mariners stopped visually following coastlines and began to cross large bodies of water. It is in ocean navigation, in fact, that mapping or chart making has reached its ultimate level. The finest nautical charts now show depth of water, prevailing wind and tidal currents, underwater formations or obstructions, navigational aids such as buoys, and hundreds of other bits of useful information.

To chart or map large areas, it was necessary to grid the whole world. This was done by establishing lateral lines (parallel with the equator) known as "parallels" or "lines of latitude," and vertical lines (running from pole to pole) called "meridians" or "lines of longitude." There is an infinite number of meridians, as a meridian by definition is any line intersecting both poles. The line on which one happens to be is known as "The Observer's Meridian." Longitudinal lines, however, are limited in number and in definite and fixed positions.

The lines of latitude begin at the equator, which is zero, and are numbered in both directions to 90 degrees at the poles. The latitude is expressed as either north or south latitude, with north often being represented by a plus sign (+) and south by a minus sign (-). A degree of latitude equals 69.4 miles.

It was necessary to establish an arbitrary starting point for measuring longitude. There was some dispute as to which was the proper starting point, with the French using "The Paris Meridian" that runs through their capital, and everyone else using "The Greenwich Meridian" that runs through Greenwich, England, and is now generally known as "The Prime Meridian." The lines of longitude are numbered outward in both directions to 180 degrees (the international dateline) and are known as east and west longitude.

One can divide a degree of latitude and a degree of longitude into sixty minutes, and each minute into sixty seconds. (One minute of longitude at the equator is one nautical mile, or 6,080.27 feet.) Even finer measurement is by hundredths of a second. Minutes are often denoted by a single mark (') and seconds by a double mark (") immediately following the given figure. Using latitude and longitude, then, it is possible to pinpoint any spot or mark off any area on the earth's surface, or to compute the airline or map distance between any two points.

Land maps in common use are U.S. Forest Service, BLM, proprietary (Metsker, Pittmon, Rand-McNally, et al.), state and U.S. Geological Survey maps. Each of these is gridded, too, but not on the basis of latitude and longitude, although these are given to locate the map in relation to the world as a whole. Most of these maps are gridded on the basis of townships.

When surveying a new area to establish boundaries for future land ownership division, the surveyers first estab-

lished a base meridian (always named) and an east-west baseline as starting points. All land within the area to be surveyed was then measured and described in relation to these two lines. When Oregon and Washington were surveyed, for example, the starting point was in the hills just west of Portland, in what is now known as the Willamette Stone Park. The meridian that cuts through the center of that stone is known as the Willamette Meridian. Running parallel to this at six-mile intervals are other north-south lines called "range lines." These are numbered outward in either direction in ordinary sequence, and the land between range line number one and the Willamette Meridian is described as "Range 1 East" or "Range 1 West of the Willamette Meridian."

The baseline that runs east and west through the Willamette Stone is not named, as far as I know. Running parallel to this line, again at six-mile intervals, are east-west lines known as "township lines." These, too, are numbered in ordinary sequence in both directions from the baseline; and the land lying between that baseline and township line one is referred to as "Township 1 South" or "Township 1 North."

One of these blocks bounded by range and township lines is known as "a township"; and the one lying in the southeast angle of the Willamette Stone would be described as follows: "Township 1 South, Range 1 East of the Willamette Meridian." Range lines are numbered on top and bottom of maps, and township lines are numbered down both sides. Simple arithmetic will tell you exactly how far you are in airline distance from the Willamette Stone.

As a township is six miles in each direction, it contains thirty-six square miles of territory. Each square mile is known as "a section" and is said to contain 640 acres of land. As all land measure is considered as if the land were level,

steep land has a much larger surface area than the official acreage, however. The method of numbering sections within a township is shown in Figure 5, and the Cruiser or Forester compass has the numbered sections engraved on the inside of the lid.

For dividing the land into smaller parcels, a section is broken into quarter sections of 160 acres, and each of these is broken into 40-acre quarters. This division can go on and on. (See Figure 5.)

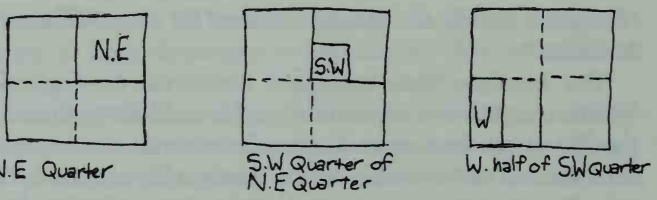

Figure 5: Land division

The original surveys govern in any dispute as to boundaries. As the original surveys were made with magnetic compasses and by several survey parties operating independently of each other, certain discrepancies exist. In southern Oregon, for instance, there is a whole series of "long sections," some of which are a nearly a quarter of a mile too long. This resulted when two survey parties met, found that their surveys were that much out of whack, and simply added enough footage to a strip of sections to bring the surveys into accord.

Absolute chaos prevails where two survey areas with different starting points meet! Along the California-Oregon border the range lines and the township lines are off between a third and a half mile! This results in a jumbled series of

fractured townships and sections along each side of the border.

Other methods of gridding exist, as in military maps, platted townsites, etc., but the principle remains the same. In each case there are numbered or named north-south and east-west lines intersecting each other at regular intervals. Either the points of intersection or any point within (or any part of) the block enclosed and bounded by grid lines can be readily and positively located and identified by reference to these lines, known as "coordinates." You can also use these lines to compute the distance between any two spots on the map. On steep land, distances between points are greater than map measurements would indicate, however.

The most useful of all maps for the ordinary person entering or traveling in relatively unknown territory is the topographical map made by the U.S. Geological Survey. These maps were made from airplane photos and give you an uncannily accurate picture of the terrain. They show the actual topography of the country by the use of contour lines at stated intervals (40 feet, 80 feet, etc.) of elevation, with every fifth line being darker in color and labeled as to the elevation at frequent intervals. The steeper and more rugged the country, the more valuable these maps become, as they will show all topographic features that are large enough to reach any two contour lines.

To more easily understand the contour principle, gradually submerge an irregular rock in a container of water, tracing the new "shoreline" at each successive half-inch depth. You will quickly see the resemblance between the tracings and the contour lines on the map. You will see that you could actually build a three-dimensional replica of the rock by using the contour lines alone, with only those features less than one-half inch high not represented. (See Figure 6.)

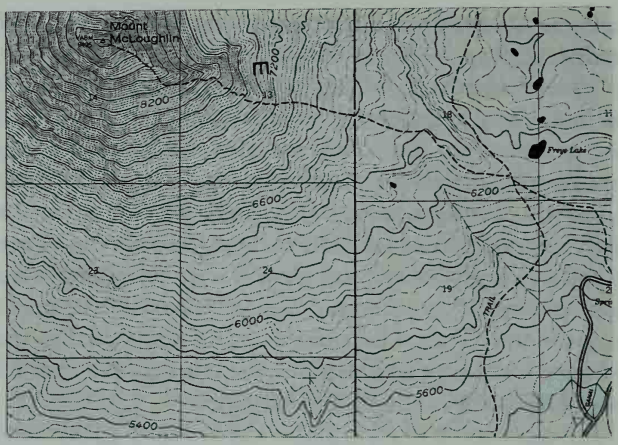

Figure 6: Contour principle

Any good map will indicate the date it was printed. Multiply the intervening years by seven to update the magnetic deviation for the area. Every nine years will yield one degree and three minutes of change (9 x 7 = 63). In any area west of the zero or Agonic Line, you must *subtract* this figure from the declination given on the map, as that line has moved toward you by that much. (In reality, it is almost or quite impossible to read within one degree of accuracy on a hand-held compass, but you might as well be as accurate as possible.)

Forest Service and Bureau of Land Management maps, as well as those produced by other federal and state agencies, are moderately priced and of good quality. Proprietary or commercial maps sold in most sporting goods and hardware stores are generally poorly reproduced copies of one or more of these government maps and are sold at more or less reasonable prices. Their only virtue, in my opinion, is their availability.

Any map will be of some help, but don't bet your life on its being absolutely accurate! Maps often show intermittent streams (as a series of blue dashes) where no surface water does or can exist, show roads that may have been planned but were never built, and show a road or trail where time has effectively eliminated all traces of one.

If you have no map (and you always should!), it is often helpful to note the courses you have traveled and the estimated distances or the time it took to travel each course, and to draw in or establish the salient features or landmarks in their proper places. Make the map by drawing the information on a piece of paper or scratching it on a piece of wood or, in a real emergency, into the stock of a rifle. Each bit of information can spell the difference between success or failure when attempting to establish or maintain location or to retrace a course. A rifle stock can be replaced; your life can't!

To stay found, you must know where you are. It does you no good to know you are in North America, in the United States, in Oregon, or even in Baker County, for example. Each of these geographic divisions is so immense that knowing you are somewhere within its boundaries gives you little help in knowing where you are. If you know, on the other hand, that you are in the Blue Mountains northeast of Granite, Oregon, and if you can see a landmark such as Gray's Peak or Mt. Ireland, then you will have no difficulty in locating yourself in relation to the country.

Remember always that *to know where you are, you must know where you are in relation to some specific landmark or place!* Only when you know where you are can you get "out" as easily as you got "in."

Chapter V

"Getting Out"

When trying to make your way out of unknown territory, it is always best to follow any road you may come upon, no matter how old or overgrown it may be. Old logging roads, tote roads, and abandoned railroad rights-of-way offer far easier travel than a cross-country course, even when vanished trestles and bridges make for frequent detours; and all such roads eventually lead to better roads and to civilization.

When you first strike such a road, you may be puzzled as to which way is out. If the land is level, just choose one of two directions and start walking; but if the land is sloping, then go down the hill. When you come to the first junction, study it carefully. Most such intersections are in the form of the letter **Y**, and the odds greatly favor the main stem as being the way to go. If the angle between the forks is such that a truck could not go from one to the other without difficulty, then probability becomes almost certainty.

Not only roads, but power lines, survey lines, abandoned mining ditches, and Forest Service trails will lead you to sites of human activity, past or present; and roads or better trails will connect these to civilization. When lost, do not abandon such well-marked routes to return to the brush and timber or to pursue a "shortcut." Hundreds of cases are on record where lost people have reached such areas of comparative safety, followed them for a short distance, then plunged back into the brush. When they have survived, most have said

they abandoned the marked route because it did not go where they wanted to go!

Don't worry as to whether or not the road is the "right" one. Finding any inhabited area is better than being lost, and you can always return to your car or camp by your original routing. Once you have reached even one inhabited home or made contact with even one person who definitely knows where he or she is, you are found!

Be on the alert for signs of human habitation or activity. Watch for rising columns of smoke and listen for man-made noises. You can hear the sounds of truck traffic for great distances, and gunshots, a dog's bark, or even the crowing of a rooster can be heard from a mile or two away if conditions are right. All of these sounds indicate human presence.

The old maxim that when lost you should always go downhill or follow the water is excellent advice if tempered with judgment. In some parts of the continent, however, streams are at the bottom of impassable canyons, wander back and forth through almost impenetrable brush, or are bordered by treacherous bogs and swamps. Streams in some parts of the western United States lead only to salty or alkaline sinks, where they disappear. In parts of Canada and Alaska, following the streams would take you away from settled areas and into the almost uninhabited Arctic. At other times, common sense would tell you to climb to a nearby crest or high point that would let you overlook the whole area.

The problem of getting out is complicated by the risk of hypothermia and dehydration.

Chapter VI

Hypothermia

The human body is a heat engine that requires four basic supplies to function: air, food, heat, and water. Air is a problem only at extreme altitudes or in tightly enclosed spaces, and food needs are rarely urgent. Given the other supplies, the body can generate its own heat. Only dehydration (water loss) and hypothermia (heat loss) normally present immediate threats to life.

The rapid and uncontrolled loss of body heat, commonly referred to in coroners' reports as "hypothermia" or "exposure," annually kills more people than any other outdoor hazard except drowning. It is so deadly because many people do not know, or refuse to believe, that a threat to life can exist "when it's not even cold"!

Hypothermia-producing weather is not necessarily cold. What matter is the degree of heat loss, and dampness and wind can raise this to deadly levels when the actual temperature is mild. The majority of deaths from exposure occur at temperatures between thirty and fifty degrees Fahrenheit and many of these fatalities take place within less than twelve hours after exposure begins!

Dampness will kill you in cold or windy weather, and it makes no difference whether that dampness is caused by external conditions or by sweating. Each droplet of water that is in contact or near contact with your skin will gradually warm to the vaporization point. As it evaporates, it will take with it the heat it took to raise it to that temperature;

and it will also steal the much greater latent heat required to vaporize it. All of this heat can come only from your body.

The vapor will travel outward through the layers of clothing until it reaches a layer cold enough to recondense it. It will turn back to water, wetting and further chilling the cold layer; and all the heat given up during condensation will be lost to the surrounding environment. The fibers of cloth then act as wicks to draw the water back into contact with the skin, and the whole cycle begins anew. Wind greatly speeds these actions by increasing the speed and the amount of evaporation.

This is classic refrigeration, quite similar to the process in your home refrigerator or freezer; but the object now subjected to cooling is your body. With wet clothing made of cotton, down, or some of the synthetics, you will lose heat from your body up to two hundred and forty times as fast as you would if the same clothes were dry! Wool and Orlon fabrics have less tendency to wick and retain heat much better, and the insulation value of some of the nonabsorbent synthetics is little affected by moisture.

Windy conditions can cause hypothermia even when all clothing is completely dry because of the "wind-chill factor." At an actual ambient temperature of forty degrees Fahrenheit, a forty-mile-per-hour wind gives an effective

Wind Speed		COOLING POWER OF WIND EXPRESSED AS "EQIVALENT CHILL TEMPERATURE"																				
Knots	M.P.H.	TEMPERATURE (FAHRENHEIT)																				
Calm	Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50	-55	-60
		EQUIVALENT CHILL TEMPERATURE																				
3-6	5	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50	-55	-65	-70
7-10	10	30	20	15	10	5	0	-10	-15	-20	-25	-35	-40	-45	-50	-60	-65	-70	-75	-80	-90	-95
11-15	15	25	15	10	0	-5	-10	-20	-25	-30	-40	-45	-50	-60	-65	-70	-80	-85	-90	-100	-105	-110
16-19	20	20	10	5	0	-10	-15	-25	-30	-35	-45	-50	-60	-65	-75	-80	-85	-95	-100	-110	-115	-120
20-23	25	15	10	0	-5	-15	-20	-30	-35	-45	-50	-60	-65	-75	-80	-90	-95	-105	-110	-120	-125	-135
24-28	30	10	5	0	-10	-20	-25	-30	-40	-50	-55	-65	-70	-80	-85	-95	-100	-110	-115	-125	-130	-140
29-32	35	10	5	-5	-10	-20	-30	-35	-40	-50	-60	-65	-75	-80	-90	-100	-105	-115	-120	-130	-135	-145
33-36	40	10	0	-5	-15	-20	-30	-35	-45	-55	-60	-70	-75	-85	-95	-100	-110	-115	-125	-130	-140	-150
LITTLE DANGER							INCREASING DANGER						GREAT DANGER									
Winds above 40 have little additional effect							*Flesh may freeze within one minute*						*Flesh may freeze within 30 seconds*									

Figure 7: Wind chill chart

temperature of ten degrees; and a true temperature of zero with the same wind is equal to fifty-three below with no wind! You would not be foolish enough to venture out at fifty-three below, but you might chance it if the thermometer reads zero. If a wind is blowing, don't! (See Figure 7.)

When it is cold and windy or wet and windy, then, you must have adequate protection or you will die. The exact danger point will depend upon the temperature and wind velocity, whether it is raining or snowing, and the type and amount of clothing available.

Think of body temperature as a balancing act between production and loss. A temporary and minor imbalance is not ordinarily dangerous; but over any considerable time the two must be exactly equal. *Internal body temperature cannot vary by more than two or three degrees plus or minus without serious consequences!*

The body generates heat by burning fuel in the form of calories. (The calorie, as the term is used in nutrition, is the large calorie or kilocalorie, equal to 1,000 small calories.) It also absorbs heat when in a warm environment and gets some heat by direct radiation from the sun or from a fire, although radiation is of little value when heavy clothing is worn. The body also absorbs heat by conduction when in direct contact with an object warmer than itself. Heated fluids or foods taken into the stomach are in direct and total contact with the internal surfaces of the body, and transfer of the surplus heat is very rapid and complete.

If production is larger than loss, you must produce less or lose more. Lower heat production by slowing your rate of exertion and get rid of surplus heat by ventilation, especially of the head and torso. If you do neither, you will sweat; and this will dampen your clothing. If no food is available (in cold weather), you cannot afford the second option, as each

calorie of heat vented to the environment is a calorie withdrawn from your reserves and wasted.

Unintentional heat loss is accomplished through respiration (cold air in, warm air out); through insensible perspiration (your body exudes warmed moisture through the skin even when you aren't sweating); by evaporation of that moisture from the skin; through heat transfer between skin and air; by conduction between the body and any colder surface in contact with it; and by the voiding of heated body waste.

If loss is larger than production, you must lose less or produce more. If you do neither, you will begin to shiver and lose a measure of control over your movements. *If the loss remains larger than production for very long, you will die!*

Reduce heat loss by putting on more and heavier clothing, by seeking shelter, or by creating a warm or heated environment (as in a shelter).

For the body to produce more heat, it must burn more fuel. Muscular activity can increase heat production by a factor of eight or more, but you must then consume high-caloric foods or draw heavily on your body's energy reserves. You will burn as much as seven hundred calories an hour during such extremes of exertion.

To deliberately produce more heat, you must fully exert your strength without accomplishing any work. Strain one muscle against another by "Indian wrestling" with yourself or attempting to move an immovable object. Try to pull up a large tree or brace your back against one large tree or rock and try to push another away with your feet or hands. When no motion is produced by the effort, all energy used will be converted directly into heat and kept within the body. No heat will be transformed into mechanical energy and wasted in useless work.

Newton's famous third law—"To every action there is always opposed an equal reaction"—explains why you

should not attempt to warm yourself by stamping your feet, running in place, or flailing your arms. Exactly 50 percent of the energy used up in such actions is expended in making dents in the snow or ground or in moving quantities of air, and neither of these help you in any way.

Continue your exercise for at least fifteen minutes to produce useful quantities of heat. This is often the only way to prevent violent, convulsive shivering when you stop to find shelter and build a fire.

This is the most dangerous time of all! Heat production will drop by 50 percent or more when you stop walking; and if you have allowed yourself to become thoroughly chilled or overly tired before stopping, internal body heat may fall to dangerously low levels.

When temperature of the blood begins to drop, the first casualty is the ability to think clearly. You will begin to make poor or even silly decisions. As the process continues, you will become more or less groggy or fall into a complete stupor, and you will not realize this is happening. As deep body heat continues to fall, the body's ability to produce heat falls still faster, and this feed-back cycle leads to death when the temperature of the vital organs falls below seventy-five degrees.

The victim of hypothermia becomes unable either to recognize the situation or to remedy it when his core temperature reaches the low nineties. He is then so apathetic or nearly unconscious as to be totally unaware of his desperate situation. This is the point of no return for a person who is alone.

Never eat snow or ice or drink cold water when body heat is marginal! It takes as much heat to melt enough snow or ice to make a cupful of water and to then bring that water to body temperature as it would take to bring a cup of cold water to a boil! Drinking cold water robs the body of less

heat than the snow or ice would, but the sudden and severe heat drain may still be sufficient to cause instant hypothermia.

Watch for hypothermia symptoms when out in cold and windy or in wet and windy weather. If alone, be especially vigilant and err on the side of excessive caution. If in a group, assign the person who has the best protection to maintain a constant observation of those other members who are poorly or less well protected.

Indicators to watch for are chattering teeth or shivering (both of which are attempts by the body to warm itself by involuntary exercise), stiff and clumsy hands, a stumbling or lurching gait, slurred or incoherent speech, or a generalized appearance of drowsiness or lassitude.

When one of a party shows such signs, the others should get him to the nearest temporary shelter, strip him of any wet clothing, and cover him with whatever dry clothing or bedding may be available. If a sleeping bag is handy, they should get him into it without delay. If he is so far gone in hypothermia that his body will not generate sufficient heat to warm the bag's interior, then another person will have to strip off all clothing and join the victim in the bag. The warmth from the second body will both warm the bag and transfer heat to the patient by body-to-body contact.

Don't allow modesty to kill a companion! It may lead to later embarrassment if two people of the opposite sex must spend some time in a sleeping bag while both are nude, but it will also allow both to remain alive to be embarrassed.

Once a victim is in dry clothing or bedding, build a fire to heat the shelter area. Heat some liquid and force the victim to drink as much as he can, at as high a temperature as he can stand. Heat some rocks (never from a stream bed or other permanently wet area!), wrap them in several layers of cloth, then pack them around the patient's body and especially the

feet. Feed him some high-calorie food if you have it. Continue the treatment until all symptoms have disappeared and full alertness has been restored.

If alone when you realize that hypothermia threatens, begin to exercise right then. Seek out the nearest sheltered site and build a fire. Exercise some more while the fire is growing large enough to heat the sheltered area, and eat some high-calorie food if you have it. Heat and drink liquids to help restore deep body heat. *Do not relax until all symptoms are gone,* as to do so may be to die.

Once the shelter area is warm, remove and dry any items of clothing that show the slightest trace of dampness. Woolen articles must be dried very slowly and carefully or they will be scorched or shrunk to the point of becoming completely worthless. Many of the synthetics are highly flammable or meltable, so dry them carefully as well.

Do not attempt to dry leather boots or shoes by direct heat, as this will crack, deform, or harden leather to make footgear unwearable. If you have plastic or other thin waterproof material, put on dry socks and wrap the sock-clad feet with pieces of this. You can then use damp or even saturated boots without drying them at all, unless the weather is so cold they will freeze. If you must dry boots and shoes, stuff them with heated, dry, absorbent material; let this absorb all the moisture it can, then remove and dry the stuffing material. Repeat the procedure as often as necessary.

When you are warm and comfortable and all of your clothing is dry, you may feel tempted to continue on your way. *You must not do so if the weather conditions that caused your problems still prevail!* Move only as far as you must to find a better campsite, one that will furnish adequate supplies of fuel for a longer stay, possibly for several days.

Make a better camp and settle down to wait for an improvement in the weather. Don't fret about those who

may be expecting you in camp or at home, or about the worry they will feel when you fail to arrive on schedule. Worrying is always preferable to mourning, and it is much better to be late than dead.

If you cannot stay warm and dry with the clothing available, do not risk further exposure!

Chapter VII

Clothing

Man is essentially a tropical animal that exists in other climates only by virtue of the artificial climates he creates in his dwellings and his clothing. By these devices, he prevents heat from being lost faster than his body can generate it.

In his shelters, man creates a heated environment by the use of external energy sources; but the heat within his clothing must normally come from within the body itself. As the body generates heat at a low rate, the clothing must be an effective insulator if man is to live and function in cold surroundings.

The insulative capacity of clothing depends primarily upon the amount of dead air it will hold, the "loft." Any low-density material that will increase the thickness will thus serve to enhance the insulation value. This allows the use of all sorts of natural substances to improve the heat-retentive ability of your clothing.

Natural materials vary widely in their value as insulation. Down from waterfowl is nearly the ultimate insulator, and the whole skins of such birds are nearly as good. Pin or tie such skins or those of smaller birds between the layers of clothing or use plucked feathers as stuffing.

The hair of members of the deer family is hollow and usually somewhat crinkly, and is one of the finest thermal insulators to be found. Caribou, elk, and moose hair is exceptionally high in insulation value. Wear a whole hide hair-side in or scrape loose hair from an old carcass and pour it inside the clothes.

The pelts of fur-bearing animals are well known insulators and are used by the Innuit (Eskimos) in preference to caribou skins or waterfowl down.

Down from cattails, fireweed, silkweed (milkweed), and thistles is very high in insulation value but tends to lose this quality rather quickly as it mats or packs. Use such plant-derived down with harsher and more mat-resistant materials for best results. Dead grasses, dry leaves, moss, and dead pine needles are good for this when used alone if they are first thoroughly dried and then crumpled to make them occupy more space.

Green bushy twigs from evergreen trees are much less effective than the materials already mentioned, but they are a great deal better than nothing. Remember that it is the dead air a material holds and not the material itself that provides the insulation.

The easiest way to insulate the legs is to tie the bottoms of your pantlegs around the tops of your boots or shoes, and then pour or stuff loose insulating material into the sacks thus created. The same technique works very well for the arms and torso.

Wind greatly complicates the problem of keeping warm. It removes heat from the unprotected skin and from the surface of the clothing; it enters the clothing itself to set up convection currents and to stir up the dead air that serves as insulation; and it greatly speeds the evaporation of moisture. You need an outer covering of windproof material to prevent these effects, and this covering must be waterproof to protect against rain or snow driven by wind. Make an emergency poncho from a sheet of plastic, a space blanket, a tarp, a large animal skin, or any wind and waterproof material. *If you can arrange no such covering, then end the exposure to wind!*

The head is the body's most effective radiator of heat, as the veins of the head will not restrict to reduce heat loss, as

do all other surface veins; and it has often been said that "to keep your feet warm, cover your head." You must make every effort to prevent excessive loss from this area. A parka-type hood is more effective than any other head covering, but a piece of fabric or other soft material wound turban fashion will serve. The skin of a rabbit or other small animal or the whole skin of a large fowl turned hair- or feather-side in will make a warm and comfortable cap. A piece of cloth tied as a handkerchief and stuffed with loose insulation will do a good job, too, but is apt to cause considerable itching. Discomfort is infinitely preferable to frostbite, however; and such a makeshift will greatly increase your ability to withstand cold weather and wind. *If you cannot adequately protect the head, end the exposure!*

The effect of wind on the bare face often limits the amount of wind you can tolerate, even when the rest of the head and body are adequately protected. Wear a balaclava helmet or ski mask if you have one, or tie a handkerchief or other fabric loosely over the face. Make a face mask from an opened-up spare sock or the skin of a bird or animal. *If you cannot protect your face, end the exposure!*

Your hands are especially sensitive to cold, and you must make every effort to keep them from becoming so stiff and clumsy that you will be rendered helpless, unable to handle matches and tinder. Ski gloves or windproof mittens over a wool or foam-rubber inner glove are best, but you can use wool socks for liners and pieces of plastic for mittens. You can also use the skins of birds or small animals as both mittens and liners by turning them wrong-side out so the fur or feathers will be on the inside. In very frigid weather or when there is snow, gloves or mittens should be tied to the clothing or to the opposite ends of a string that is threaded in one sleeve and out the other. This will prevent loss and ensuing misery. *If you cannot protect your hands, end the exposure!*

Your feet are also highly vulnerable to cold, being both far removed from the torso where heat is generated and in contact with the ground or snow. There are a number of types of footgear on the market that are guaranteed to keep you warmly shod under any conceivable circumstance; and if you are lucky enough (or foresighted enough) to be wearing such boots, then keeping your feet warm will present no problem. With normal footgear, the problems can range from mild to severe and desperate.

A satisfactory substitute for thermal boots can be made by wrapping the bare feet in plastic, pieces of space blanket, or other thin, waterproof material, putting on one or more pairs of heavy socks, then wrapping these with another waterproof covering. Moisture cannot penetrate the socks to destroy their ability to insulate, and the waterproofing barriers add some insulation value as well. This is the famous "Korean" or "Mickey Mouse" boot in crude form.

The "Mormon moccasins" of pioneer days were opened-up burlap sacks wrapped in multiple layers and tied around the boots or shoes. The skin of an animal or the seatcovers or headliner of a car will serve as well; and you can even wind or tie evergreen twigs, twisted bundles of dead grass, rushes, or plaited cattail leaves in a layer several inches thick. This cover will pack full of snow and will furnish a high degree of insulation. These will quickly wear out if worn on bare ground, but will last well in snow, where they will also leave monstrous tracks that would convince an observer that he has stumbled on the trail of Bigfoot!

The skins of small animals such as rabbits make splendid lounging moccasins for use around camp and are near-perfect substitutes for socks if the footgear is roomy enough to permit their use. They are too fragile to wear as boots unless protected by more durable material.

You can make moccasins from blankets, from carpets or floor mats from a car, from rawhide from animals such as deer, or even from a cut section of tire. With all but the tire, you can cut the material and sew it (using electrical wire from the car, perhaps) in conventional pattern; or you can simply place your foot in the middle of a piece of material at least eighteen inches square, then fold and tie this around the foot and ankle. With the section of tire, you must insulate the foot with other materials (grass, rabbit skin, blanket moccasins, etc.) and slip the trough-shaped piece of tire over this.

The Thule Innuit (Eskimos), who live within nine hundred miles of the North Pole, use sealskin outer boots or "kamiks" with bearskin soles, and inside these they wear inner boots made of rabbit skin with the hair turned in. To improve insulation of the feet, they place a thick pad of dry grass (collected and stored in summer) between the soles of the inner and outer boots. While you are not likely to have sealskin or polar bear skin available, the grass will work as well for you as for them, especially as you are not going to be walking on ice at sub-zero temperatures.

If stranded by a stalled or disabled car in severe weather and you find your clothing inadequate, the appointments of the car itself can be life savers. Most car seats today are padded with rubber or plastic foam, and this is splendid insulation. Cut through the seatcover (save and use this also) and remove the padding in large pieces. Use these to insulate your clothing. Don't forget that many cars have padded dashboards, many engine compartments are insulated with fiberglass, and many carpets are underlaid with sound-absorbing pads.

Seat belts can be used as belts, suspenders, or pack straps; and carpets, floor mats, headliners, and seatcovers can be used in many ways not already mentioned. Improvisation is

the name of the game in a survival situation, so use your imagination. *Don't hesitate to salvage these items if you need them. A car is expendable, but your life is not!*

If your clothing will still not keep you dry and warm despite such improvisations, end the exposure. Remember that no other objective can be as important as staying alive and in possession of your ears, fingers, toes, and limbs. *If you cannot stay dry and warm with the clothing and materials available, build a shelter to protect against further exposure!*

Chapter VIII

Winter Shelters

A winter survival shelter has only one purpose: to enclose an environment more suitable to human requirements than that which prevails outside its walls. This being so, it follows that the smaller and more tightly enclosed the shelter, the easier it will be to create and maintain such an environment within it.

The type of shelter you choose to build should be determined by the area in which you find yourself, the weather conditions prevailing there, and the materials available without excessive expenditure of energy.

A shelter site must meet certain criteria: a shelter must not be built in an area subject to flooding, in the pathway of possible snow or rock avalanches, in the lee of an obstruction where drifting snow would bury it, or within reach of standing dead trees or large dead limbs. It does little good to take shelter from the weather in places where one of these hazards is every bit as threatening. The sites must have (if possible) an easily obtainable supply of fuel large enough to last for some time without skimping, suitable materials for constructing the shelter and a source of water. Snow makes water available everywhere, but melting snow is a slow and irksome process, and is next to impossible without suitable pans or kettles. If food animals and/or plants are in evidence, so much the better; but these are not absolutely required in the short term.

If you are caught out at night in cold but not stormy weather, you can make a reasonably comfortable bed against or alongside a large log. Clear a space seven or eight feet long and two or three feet wide alongside the log, digging clear down to the mineral dirt to prevent fire from spreading. Bank some of this dirt against the log to prevent its catching fire. Build a fire, of hardwood or heavy bark if possible, to cover the cleared area. Keep it burning for at least an hour to thoroughly heat the ground, then rake the fire out of its bed, moving it from four to six feet outward from the cleared area. The new fire site should also be cleared of all burnable material before the fire is moved. Make sure no burning material is left behind.

Cover the heated area of ground with a thin layer of dirt for safety. Place a small log or a wall of rocks along its outer edge and fill the space between it and the large log with small evergreen boughs, dry grass, moss, dead pine needles, or any other resilient material. Make this mat a foot or more thick and tuck all stiff stems or twigs well down inside. This is to be your mattress, so take some pains to make it a comfortable one.

Lay rafter poles across the large log in such fashion that the projecting "eaves" overhang your bed, and roof this overhang with bark or boughs. This will catch and reflect the heat from your fire, especially if you make a suitable reflector on the far side of the fire.

Be sure to collect enough wood to last the night, remembering as you do that the fire is as long as your bed and will consume a great deal of fuel. Gather as much as you think you'll need, then add twice that much more! Late-season nights are long, and they often get very cold; and it is far better to have more than enough wood than to run out before morning.

If you wish to do so, it is easy enough to contrive a coverlet or comforter of sorts. Simply lay two slender poles par-

allel to the side logs and sixteen to eighteen inches apart atop your mattress. Lay some small sticks across these and heap on small boughs, dry grass, dead leaves, or pine needles in as thick a layer as you think necessary. (All of these materials should be assembled before dark.) Carefully lift one end of both poles and wriggle into the cavity thus created, then allow the covering material to settle over you. This will block off the reflected heat of the fire, but it will help retain the heat from the ground. A much smaller fire will then serve.

If in treeless country, build your fire in the lee of a large rock or ledge and surround it with an embankment of sand or dirt topped with a row of fist-sized or larger rocks. (These must not come from creek beds or other seasonally wet areas!) When the sand and these rocks have been thoroughly heated, move the fire to a new location several feet away. Cover the old fire site with the heated rocks and completely bury these with the heated sand or dirt. Cover this with a thick layer of dry grass or similar vegetation, or with a thin layer of cooler sand or dirt. This is your bed, and the heated rocks and sand beneath it will retain heat for several hours.

If you get cold because of the cooling of your bed, transfer the fire back to its first location and bed down on the newly vacated site. You should then be able to sleep the rest of the night.

You should have no trouble building a decent shelter in timbered country. Many evergreen trees have boughs that droop almost or quite to the ground to form ready-made huts, and a heavy snow cover makes these even more suitable as shelters. Strip a few boughs to make headroom and use these and others procured from nearby trees to make an insulating floor cover at least a foot deep. Weave still more boughs into the walls and overhead or use slabs of bark if these are easily obtained. You

can use plastic film or a space blanket for further weatherproofing if you have them.

An alternate of this is to dig a pit around the straight trunk of a tree, digging clear down to bare dirt. Roof this pit with cross poles covered with branches or bark. Again cover the floor with a mat of vegetation a foot or more thick. Make a shield of rocks or dirt against the base of the trunk to protect it from damage and build your fire against this. The tree will actually serve as a primitive chimney, as the smoke will tend to follow it up and out of the shelter through a hole left for the purpose.

In timbered country, you can also often find a large uprooted tree, and there will usually be a large vertical wall of dirt covering the roots. Deepen or square the hole left by the uprooting and use the dirt to build an embankment on the side opposite the root wall. Lay rafter poles over these two walls and cover them with boughs or bark. Build your fire against the root wall and make a smoke hole in the roof directly above it. Fill the bottom of the hole with flooring material a foot or more thick. The wall of dirt covering the roots makes a splendid fire reflector, so build a bed at the lower or opposite end of the shelter.

Find a dense young evergreen tree that is fifteen to twenty feet tall. Use a pole to shake snow off its branches. Chop or shoot into the tree trunk at a point five or six feet above the snow level. Use the pole to push the tree over so that its tip is resting on the snow. The butt will still be hooked to the stump, and the tree will slant steeply downward to the tip. Trim out all bottom branches and dig the snow from beneath the trunk to make a trench to ground level. Floor this with a layer of boughs or other vegetation at least a foot thick. Cut into all branches on the top and sides and break them down to rest on the snow. Stack other loose boughs over the top to make this brushpile a foot or more thick.

Heap snow over this to provide additional insulation. Build a fire shield and reflector against the stump and make your fire against this. This "den" will protect you against anything but warm rain or a sudden, massive thaw.

Lean a pole and bough roof against a large log or lay one over two parallel logs. Make a combination floor and bed of boughs and bark or of boughs alone. Cover one end with a slab of bark or with a woven mat of boughs to serve as a door. Cover the roof with dirt and leaves or with snow to insulate it. Build a fire three feet or so from the open end and make a reflector behind it. Place a plentiful supply of wood within easy reach, leaning some of it against the logs that form your walls. The heat of the fire will dry your wood as it warms the shelter, and you can refuel the fire without leaving the shelter. Don't be alarmed if the side logs catch fire, as you can easily prevent the flames from progressing too far by plastering them with dirt or snow.

Make a teepee by jamming the tips of several poles into the bark of a tree and spreading the butts in a circle. Half a teepee is often all the room you need, and you can spread the poles in a half circle only. Cut or break branches on top of these poles to leave stubs several inches long. Hang the forks of the first thatching boughs over these stubs. Thatch heavily and cover the floor with insulating material. Use large boughs to cover the open side of a half teepee and to provide access. Make a fire shield and reflector against the tree trunk.

In treeless country you can make a wickiup by lashing the tips of tall bushes together and weaving other brush into the framework thus formed. A framework of slender willow saplings with cattail leaves woven as walls is splendid, but you can use twisted bunches of grass as thatching instead. Leave a smoke vent in the top center of your wickiup and build your fire in the center of the floor space. If you cannot find a clump of saplings that can be used in place, you can

add others by driving stakes and lashing the butts of gathered poles to them.

Build a lean-to by placing a ridgepole between supports or by using one large rock as a ridgepole. Place smaller poles with one end on this and the other end on a small log parallel to it. Lay still smaller poles over these to form thatch supports. Thatch heavily and cover with snow or with dirt and leaves. Make a thick floor covering and build a bough bed against the smaller log. Cover the open sides with slabs of bark or with large boughs. Build a fire at the high end and make a smoke hole directly above it. This is especially good when the ridgepole is a large boulder, as the rock not only holds up your roof but serves as an ideal fire reflector. You can even lean poles at a steep angle against a cliff to create a very steep-roofed shelter that looks like half of an A-frame structure.

Make a snow cave by tunneling into a compacted drift or under a heavy crust. Make an open semicave by heaping snow walls or by digging or stamping a triangular trench. Floor with boughs or bark and build a raised bed between two points of the triangle. Roof this area, but leave the third corner uncovered. Build a **V**-shaped fire reflector in the unroofed angle and make your fire there. With the dug cave, place the fire and reflector just outside the cave mouth.

Make a snow hut by rolling and stacking snowballs or by breaking thick crusts of snow to serve as building blocks. You cannot build a proper igloo without a snow knife or machete and a great deal of specialized expertise. It is far easier just to build snow walls and roof the hut by using poles or skis covered with brush or with large chunks of frozen crust than it is to make a self-supporting dome out of snow blocks.

In open country where poles and brush are not at hand, you can hollow out a chamber beneath a crusted drift. Make

the lid resemble that of a jack-o-lantern, sharply slanted so that its taper will hold it in place. This type shelter is especially valuable when seeking shelter from a snow storm or blizzard in treeless terrain or when the only source of heat is a candle or primus stove. Be sure to poke a stick through the crust to make a ventilation hole, and keep the stick with you so you can use it to keep the hole unclogged. Line the chamber with whatever vegetation may be at hand or with floor mats or carpets from your car.

The Mandan, Navaho, Pawnee, Pima, and Mojave Indians used mound- or loaf-shaped huts made of timbers and brush covered with a thick layer of dirt. The Thule Innuit used dirt and rock igloos, as did prehistoric Aleuts. Such a shelter is unexcelled for warmth in cold weather, but will take considerable effort to build. If you decide to make one (as for a long stay), look for an existing depression that can be deepened to form the lower part of the hut, and use the material removed to cover the top. If the ground is frozen, build a fire to thaw the ground so you can work it.

Desert streams tend to cut very deep channels, and the dirt and rock walls of such miniature gorges are often pocked with shallow caves. This is especially true just below the rim. When the ground is frozen, you can safely deepen such holes to make a room large enough to crawl into. If you can find some suitable material for shoring up the roof, you can make a much larger room and dig a fireplace at the inner end. If possible, use rocks and dirt to build a short chimney around the smoke hole, extending it somewhat above ground level to make it draw better. Use a mat of brush as a door, but don't make it airtight. Don't use such sites when the weather is such that thunderstorms can possibly dump large amounts of rain on the headwaters of the stream, as dry or almost dry watercourses can be filled up to their banks in a matter of minutes.

You will rarely find a true rock cave when you need an emergency shelter, but you will often find large rocks leaning against each other to form cavelike niches. You may even find such a crevice that has a chink or hole ideally placed to let smoke out. Fill other cracks with snow, dirt, gravel, or vegetation to prevent drafts, lay a thick floor of boughs or brush, and make a door from dense young evergreens, a slab of bark, or a woven mat of brush. Build your fire against one of the interior walls if there is a good way for smoke to escape. If there is no smoke vent, build a fire just outside or just inside the entrance if the entrance is wide enough to let you pass the fire to go in and out, make a reflector behind it, and omit the door.

An overhanging rock ledge or a large undercut boulder offers splendid shelter potential. Lean poles against the ledge or boulder and thatch these poles to cover the three open sides. Alternatively, you can stack rocks to make a wall several feet from the fixed rock and make a pole-and-thatch roof. A fire built against a boulder or rockface will heat the shelter almost as well as a stove.

Old abandoned mine shafts and even prospect holes offer marvelous opportunities for shelter building. The mine tunnels must not be used unless they seem solid and not at all likely to cave in. Even then, it is best to make a wall to block off the entrance and another to partition off a small room, rather than to go deeper into the tunnel. You can store your fuel supply against this wall or use it as part of the wall to help block escape of your heated atmosphere.

A stick and wattle shelter takes considerable effort to build, but is well worth the effort if materials are readily at hand and you expect a somewhat lengthy stay. Drive a double row of stakes (use standing small saplings when properly placed) and fill the space between the stakes with tamped brush or boughs, or with brush plastered with mud. This

was the type of house built by the first English immigrants to this country, despite the pictures showing neat log cabins. Make a roof of thatch or whatever you can find.

A combination dugout and sod house is another splendid shelter. Simply dig a shallow cave in a steep sidehill and cover the entry with a wall constructed of cut sod or rammed earth. A rammed earth wall is very similar to the stick and wattle wall, except that the sticks are tied to make forms that are then filled with tamped dirt.

All sorts of teepees, lean-tos, and shed-type structures can be made from plastic sheets or space blankets. Remember that these will condense so badly as to be worse than useless unless adequate ventilation is provided and maintained. Leave at least one side open to permit enough air circulation to carry the moisture away.

The interior walls of any shelter built of snow or of any material that will either leak or condense moisture must be made as smooth as possible, as any projections will serve as drip points. When such a point is unavoidable, it is often possible to hang a slanting trough of bark or a smooth stick beneath the point to catch the water and drain it away. It is also advisable to dig a shallow trench around the inside base of such walls to safely channel all water away.

In nearly airtight or meltable shelters, you can use a few heated rocks as a heat source. Build a fire just outside and heat a number of softball-sized rocks (never gather these from a permanently wet area!) in it. Use green stick tongs to transfer the heated rocks to a dug pit or dirt-covered platform inside the shelter. A heated rock will radiate heat for a considerable time, and two or three such rocks will furnish as much heat as a small fire.

The Chinese in colder parts of Asia use hollow beds made of baked clay. They place burning charcoal in these "kangs" to furnish heat throughout the night. You can make a crude

substitute by digging a trench across the floor of the shelter, roofing this with flat rocks plastered with mud, and building a stick-and-mud or rock-and-mud chimney at one end. Build a fire in a covered pit at the other end to heat both the shelter and your bed.

A stove is vastly superior to the best possible fireplace, and you can make a crude stove out of pieces of flat rock such as granite, sandstone, shale, or slate. You can make an even better one with metal salvaged from a car or plane. If you have tools to remove them, be sure to salvage the hood or trunk lid if stranded by a broken-down car. Use one of these for the lid of a rock stove or a dug fire pit, first burning the paint off by laying it on a hot fire outside the shelter. If you neglect this, your shelter will be filled with noxious fumes as the paint burns. You can also use the metal as the inner wall of a fireplace chimney by blocking it a short distance from a dirt or rock backwall. When heated by the rising smoke, such a chimney will radiate a lot of heat. You can also use a hood or trunk lid as part of the external wall, with the fire built outside the shelter.

The best roofing material is bark, and you can easily strip this from rotting logs without the use of tools. It is so heavy that you do not need to weight it, sheds water very well if properly laid, and is an efficient insulator. Best of all, you do not have to expend much energy to get it.

Evergreen, coniferous boughs make good thatch, but you must use them properly. You must lay them at a steep pitch to make them shed water at all well, lay them in thick masses to provide much insulation value, and weight them with other material to prevent wind motion. You must take care to lay them with the butts up and the tips down, and turned right-side up, just as they grew on the tree. Laid in this fashion, the needles are so pointed that water will drain down and off.

Bundles of grass, cattail leaves, rushes, reeds, etc., make splendid thatch, provided only that the bundles are laid in several thicknesses and in such a fashion that each layer of bundles overlaps and covers the gaps between lower layers. If you have a sheet of plastic, you can throw thatching material on without tying it in bundles or taking any great pains to orient the stems or the leaves, covering the whole with the plastic held just off the thatch. Vapor from inside the shelter will pass through the thatch and condense on the plastic; and this condensation will then drain down and off.

Many of the shelters described are for long-term use, and it is most unlikely that you will need anything so elaborate. Cases abound where people were downed in a plane, wrecked in a ship or boat, or simply became hopelessly lost for considerable periods, however; and a fancier or more comfortable shelter would have eased their misery. You alone must decide the type of shelter needed in light of the situation.

Remember that it is vital that you not work at a pace that will cause sweating when you are building an emergency shelter or gathering building materials or fuel. This will dampen your clothing and rob you of a great deal of body heat; and it will also waste a large quantity of stored energy. You have a limited supply of energy in reserve, so husband it as if your life depended on it. It well may!

As important as knowing how to build a shelter might be, it is just as important to know how to live in one.

Chapter IX

Shelter Living

Conduction is the transference of heat from a warmer to a colder object by direct contact, and the speed and amount of the transfer depend upon both the temperature difference and the nature (texture and content) of the surfaces involved. A smooth surface will obviously allow a much greater area of actual contact than a rough surface of the same size, and it is more likely to be very hot or very cold. Metal and stone feel much colder than wood, and smooth wood feels colder than a rough piece of bark. The coldest of all, of course, is a smooth sheet of ice.

It is vitally important, then, that you prevent direct body contact with ice, snow, frozen ground, or the surfaces of rocks. It is for this reason that I have repeatedly stressed the need to make a floor of bark, boughs, pine needles, dead grass, or other insulating material laid in considerable depth.

It is the danger of conduction, too, that makes a car an attractive hazard as a shelter. The car is made of metal, is poorly insulated, and is very unlikely to be stalled or stuck at or near a good supply of fuel or in a sheltered area. During a howling blizzard or in wide-open, treeless country, you should stay with the car at all costs. In most circumstances, however, you should seek out the nearest site that offers the essentials for shelter making and living. *Do not leave the car without leaving a message for a rescue party, telling them which direction you went, when, and why.*

If there should be an adequate fuel supply near the car, then you might well choose to stay there. In that case, build a fire near the car but far enough away to reduce fire or explosion hazard, heat some rocks (never from a wet area!) in it, and use them to heat the car. A hub cap placed on a pile of rocks or in the center of a spare wheel will serve to keep hot rocks off flammable or meltable carpets.

Do not attempt to live in (or to build) a snow shelter when the temperature is at or above the freezing point. Handling snow under such conditions will wet your clothing and rob you of a great deal of heat. When living in such shelters, your body heat alone will raise the temperature significantly; and if the raised temperature is then above freezing, you will have damp and drippy quarters.

If in colder temperatures you find the heat of your fire beginning to melt the interior surfaces of your shelter, there are several useful steps you can take. Lining the structure with bark or boughs will help insulate it, and will let you use somewhat higher heat levels. Enlargement of the smoke vent or roofless area will let more heat escape, and enlargement of the doorway or thinning or removal of the door material will let more cold air enter.

With reasonably adequate clothing and complete protection from the wind, you can stay relatively comfortable with the temperature somewhat below freezing. It is much better to be chilly and dry than to be warm and wet.

A very real problem in severe weather is the elimination of body wastes. The single largest cause of death among the German troops outside Moscow in the winter of 1941 was officially listed as "congelation of the anus." This translates as freezing of the bowel or colon and was brought about by the combination of widespread dysentery and unprotected and unheated latrine areas. If the weather is only moderately cold, you can use a well-protected spot near your shelter

as a latrine. If the temperature is very low or if it is both cold and windy, you must either build a latrine shelter you can heat or make a "chamber pot" you can use in your shelter. This can be a slab of bark or other material that can be carried out and buried with its contents.

Remember when selecting a latrine area or a dumping ground for your chamber pot that the wastes may remain frozen until the main thaw, but will then be released to the environment. Be careful to select an area that will not allow them to be carried into a watercourse or otherwise create a pollution threat when spring comes.

Snow is a great thief, and any article left outside the shelter in winter is apt to be buried and lost. Take everything but a firearm into the shelter with you. The chilled metal of a gun will sweat (condense moisture from warm air) if taken into a heated atmosphere; and ice may then form in the barrel when you take it outside again, dangerously restricting the bore. Other metal parts may be effectively welded into a single immovable block by freezing. Leave the weapon outside the shelter, perhaps hanging it upside down from a lower branch of a dense young evergreen. If you are unwilling to be separated from your gun, then first warm it to room temperature and then thoroughly dry it, taking special pains with the bore.

Snow plus heat equals water. Whenever you leave your shelter in snowy conditions, your boots and possibly your clothing will pick up some snow. If you enter your shelter without first removing this snow, it will melt, dampening both your clothing and the shelter floor. Use a small evergreen bough or a bunch of dried grass as a whisk to brush all snow off clothing while still outside. If falling or blowing snow tends to replace it as fast as you can brush it off, then you must make some sort of porch or anteroom that is unheated but offers some protection.

Extra clothing and all bedding material should be kept as dry and as clean as possible. Dry such items at the first sign of dampness and fluff them at every opportunity. This will both help to retain the bulk or "loft" of the material and prevent the buildup of insulation-robbing moisture.

Keep a supply of drinking water at hand if at all possible, and keep it heated to well above body temperature. Use it with or without flavoring, such as one of the vegetable teas mentioned in Chapter XIX if you have no regular tea or coffee. Drink the equivalent of a large glass of it at frequent intervals, whether or not you are thirsty. The water will prevent dehydration and the heat will help maintain your core temperature without burning any of your reserve energy.

Living in a winter shelter requires the maintenance of an adequate fire.

Chapter X

Fire Making

Heat means fire and fires must be started. This requires a means of ignition, tinder to be ignited, and fuel to burn. It also helps immensely to have some sort of dry and heat-reflective material such as aluminum foil to build a fire on.

The best and surest means of ignition is the common wooden or kitchen match. Dip some of these in melted wax to make them waterproof, after first testing them for dryness or drying them in a slow oven to make sure you are sealing dampness out, not in. The wax will completely protect the match from moisture, will not hinder striking, and will make the match burn much more hotly when lit. Carry some of these in each of several pockets and at least a few in a watertight container with a sandpaper striker glued to it or in a commercial match safe, in addition to a plentiful supply in your emergency kit. Matches are cheap and easily waterproofed, so always carry more than an adequate supply.

Almost as effective and only slightly more costly are the butane-fueled lighters now on the market. Include one of these in your fishing or hunting gear and perhaps another in your pocket in addition to the one in your emergency kit. Other types of cigarette lighters are valuable, too; but most require that you refill them with fluid and replace the flints occasionally, where the cheaper butane models are simply replaced. *Butane will freeze and the gas will not flow at near-freezing temperatures, so you must transfer one of these to an inner pocket when the weather is cold.*

Make tinder by soaking blocks of absorbent, burnable material in hot wax. Cardboard, paperboard, acoustic tile, cotton rope, and folded cotton cloths are excellent, and loosely rolled or folded paper towel or toilet paper will serve. Cut into short lengths or small blocks and drop these in a container of melted wax. Hold them under the surface with a fork until all air bubbles cease, then lift them to a rack or screen to let them harden. These blocks will be totally waterproof and easy to light under most conditions, and will burn long enough and hotly enough to ignite even ice-coated twigs. Best of all, one of these blocks will furnish enough heat to restore a measure of dexterity to cold-numbed hands.

A small can or two of Sterno is very good "life insurance" if the time and locale are such that sudden blizzards might occur. You can pry the lid off one of these cans or puncture the can or lid even when your hands are almost clubs, and even a spark will then ignite the alcohol. This will burn hotly enough to ignite other fuels even in windy or rainy conditions. You can often slide the can from beneath the blazing fuel, recap it, and save part of its contents for future need.

You are often told how valuable birchbark is for starting fires, but you are seldom told that this is true only of the paperbark birches; and you are never told that these do not even exist in two-thirds of the country. This bark exfoliates (peels) in very thin sheets that are like oiled paper (although the bark looks solid on the tree); and these thin sheets will burn much like oil- or grease-soaked paper. It takes an actual flame, not a spark, to ignite it. Water has little effect on this quality. Most species of birch do not have this useful feature.

Other tinders that can be lighted easily with a flame are animal fat; camera film; dry, shredded pinecones; pitch shavings; paper; wispy dead wood left by termites; and resinous

dead conifer twigs. Good pitch shavings will light even when wet. Film from a camera will light and burn almost explosively.

Tinders that can be lighted with a spark are dry, powdered bird droppings; dry manure from grass-eating animals; downy feathers or plant down; human or other hair, pounded and wadded; dry grass or pine needles rubbed to a fibrous pulp; and fine, rotted wood powder. The fine dust left by termites, carpenter ants, or wood-boring beetles is also very good. Each of these must be perfectly dry to be usable.

Make emergency tinder from cotton cloth. Pound a piece of handkerchief between rocks to reduce it a pulpy, linty mass. The tiniest spark will start a smoldering fire in this lint, and you can easily blow this into flame. If you have no other tinder on hand and expect to build up more than one fire, tear your cotton handkerchief into three equal strips, roll each of these into a several-walled tube, then plait these together to make a crude rope. Pulp one end by pounding. When a spark has landed in the lint, grasp the other end of the rope and twirl it rapidly to fan the fire. Extinguish it by pounding the burning end between rocks or by smothering it with the sole of your boot after starting a fire with it. The partly charred end will be even easier to light the next time you use it.

You can make sparks with a "metal match," a patented item available in stores and by mail order. Scrape it with a knife edge or with the scraper furnished with it. Scrape slowly to produce burnable particles to mix with other tinder, or rapidly to produce a shower of superheated, long-lived sparks. Being made of metal, this igniter is totally impervious to water. It is a valuable piece of emergency gear.

Even an out-of-fuel cigarette lighter can be used to send a shower of hot sparks into a bed of tinder. Some people carry a lantern, stove, or cutting-torch lighter. The torch lighter consists of a wire bent into a long, narrow **U**-shape, with one

end fastened to a metal cup that contains a piece of file, and with the other end bent in a right angle and tipped with a piece of commercial flint. The bent wire serves as a spring, and the cup serves to focus and direct the sparks produced by grating the flint against the file. The stove lighter works like a pair of spring-loaded pliers, and the lantern lighter spins a serrated steel wheel against flint. All three produce showers of superhot and long-lasting sparks.

You can make sparks by stroking a piece of steel such as your knife blade or a sharpening steel against a very hard rock such as agate, chrysolite, feldspar, flint, garnet, hematite, iron pyrites (fool's gold), jasper, magnetite, quartz, or any other rock that is too hard for your knife to scratch easily. You can even make sparks by striking two chunks of iron pyrites or magnetite together, although you are more likely to wind up with smashed fingers than with fire. Look for suitable rocks in the gravel bars along streams or where ledges protrude through snow or forest duff.

When using a smallish rock and steel, it is best to hold the tinder cupped in the palm of your weaker hand, with the fingers of the same hand holding the rock in position just above the tinder. The steel is grasped with the other hand and stroked briskly and repeatedly against the rock in such fashion that all sparks are driven into the tinder.

When using two rocks or one large rock and a large piece of steel such as a hatchet, the best technique is to put the tinder on a piece of bark or tinfoil placed on a large rock or piece of wood. Kneel beside this and hold one rock in the weaker hand just above the tinder. Take the other rock or the steel in the stronger hand and strike it in a glancing downward fashion against the stationary rock. Do this repeatedly and as rapidly as you can manage.

When a spark catches and "holds," the signal will be a fine thread of smoke. Pick up the bundle of tinder and either

blow gently on the spark or wave the bundle back and forth to fan the spark to greater life.

Any tinder is vastly improved by being charred, and many natural tinders that you could not otherwise use are rendered useful by this process. Among these are: the shreddy outer bark of cedar, cliff rose, cypress, grape, honeysuckle, juniper, and sagebrush, all of them excellent. The inner bark of dead aspen, cottonwood, poplar, and willow are good. Fair to good charred timbers can be made from the pith of such weeds as fireweed, mullein, and sunflowers, or from that of shrubs such as elderberry, mock orange, or ocean spray. Dried fungi such as puffballs found on oak trees, the "conks" on diseased coniferous trees, and dry mushrooms such as puffballs and bracket fungi found on dead trees and logs are excellent.

Any nonresinous softwood, either green or dry, can be used as charred tinder. Scrape with the edge of a knife, a sea shell, a sharp-edged rock, or a piece of broken glass to produce very thin scrapings. *Do not whittle.* Scrape, as in paint removal. Burn or char these scrapings in the absence of oxygen and rub or grind into a powder.

Prepare any charred timber by heating the material in an airtight container or by smothering burning material in very dry dust or ashes. Carry or store the material in an empty shotgun shell or cartridge case with a whittled plug for a stopper. You can also carry it in a section of elderberry or other pithy stem with the pith punched out or in a hollow bone plugged at both ends. *Once you have started a fire by primitive means, do not neglect the making of some charred tinder to make future fire starts easier and more certain.* The best of all charred tinders is cotton or linen cloth.

These are makeshifts at best and should be reserved for playtime. You should not bet your life on them! *Carry matches and tinder!*

You can start a fire with a firearm. Pry out the wadding of a shotgun shell or remove the bullet from a metal cartridge. With a blunt-nosed bullet, you will have to lay the neck of the cartridge on a rock and tap all around it with the back of a knife blade or a sharp-edged rock, unless you have pliers, a Leatherman Tool, or similar device. With a pointed bullet, you can use the gun muzzle for a vise. Insert the bullet in the muzzle as far as it will go, then wiggle the cartridge to stretch the case neck slightly to loosen the bullet. Try the cartridge in the chamber, as wiggling or tapping may have enlarged or deformed the neck to the point that you must grind it to make it fit. Remember, though, that you can safely use very considerable force on the action, especially with a bolt action gun. The removal of the bullet will have removed the danger of damage to the gun or to you, even if the cartridge fires.

Discard the bullet or the shot. Dump all but a small part of the powder into a prepared base of tinder and fuel. Tear a small piece of cotton cloth, pulp this by pounding or fraying, and twist it loosely into the cartridge or shell. Chamber the cartridge or shell, point the gun muzzle straight up, and pull the trigger. The cloth will be ignited and blown into the air, and its flight will fan the flames. Scoop up the blazing cloth and use it to light the powder mixed with the tinder. Repeat the process if necessary, this time twisting a little powder into the cloth.

This often works very well with a shotgun or large-caliber rifle or pistol, but it will not work dependably with a small-caliber weapon. It will not work at all if it is raining, snowing, or very windy, or when your hands are too stiff and clumsy from cold to do all this. *Carry matches and tinder!*

You can start a fire with a bow and drill. You need a bow, a fireboard, a drill, and a socket. You will also need an uncommon lot of luck! The wood for the drill must be non-

resinous and bone-dry softwood such as aspen, cedar, cottonwood, juniper, larch, tamarack, willow, or yucca. You must find it when you need it and you must have enough remaining energy and manual dexterity to do the tedious and time-consuming work. One drop of water or one vagrant gust of wind will spell defeat and possible death. *Carry waterproof matches and tinder!*

Make a fireboard from a piece of one of the woods listed above that can be split or whittled to make a flat spot near one end. It must be at least two or three inches wide, an inch or more thick after being shaped, and at least eighteen inches long. Use the point of a knife or a pointed stone to start a half-inch-wide hole an inch or so from one edge. Cut an undercut, **V**-shaped notch in and through the edge of the board, with the point of the **V** cutting the side of the hole. The hole needs to be just deep enough to house the taper of the drill. Finish the hole by grinding with the drill, shaping both at the same time. The notch and hole will look much like a keyhole for a skeleton key.

Make the drill about one-half to three-quarters of an inch in diameter and a foot or more long. Taper the small end to not more than a quarter inch in size, round it, and polish it as smoothly as you can. Make a blunt and shallow taper on the other end. Make the drill six- or eight-faceted where the string is to run and remove all projections or rough spots that might fray or damage the string.

Make a socket from a knot, a chunk of wood, or a smooth rock that has an indentation on one side. This is used as a bearing to hold the top of the spinning drill, and you should lubricate it if at all possible. The graphite (lead) of a pencil is perfect for this, and you can rub it with a lead-tipped bullet, instead. A bit of animal fat or the wax from your ear will serve. Even the oil obtained by rubbing the drill tip against the side of your nose or through your hair will help, and a

bit of pine gum rubbed into the upper drill tip will form a glaze that will help reduce friction. *Do not use water as a lubricant!*

You can make a bow from a springy green branch, making it in conventional bow shape and not less than two feet long, but it is far better to make a more or less triangular bow from the trunk and limb of a bush or sapling. Either cut grooves for the string or drill holes for it if you have a knife with a reamer. The hole is far superior to a groove, especially on the handle end.

Use a bootlace, fishline, raveled threads twisted into string, or any other flexible cord for a bowstring. You cannot use wire, as it would quickly break from metal fatigue. As the string will often stretch during use, a means of tightening it is essential; several methods are shown in Figure 8.

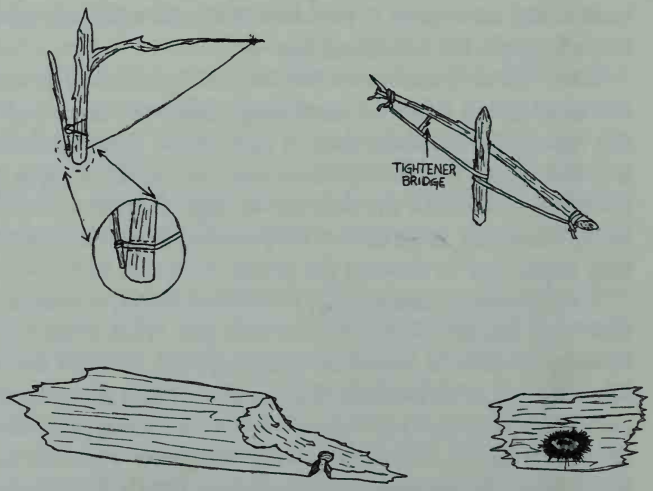

Figure 8: Bow and drill

Tie the bowstring to one end of the bow, loop it once around the drill, and tie it to the other end, keeping it as tight as you can. Kneel on the right knee and plant the left foot firmly and solidly on the fireboard to keep it from moving about. Place a wad of tinder under the notch, putting it on a piece of foil, plastic, bark, or wood so the tinder can be moved without being scattered. Drop a few grains of sand or gritty charcoal from a burned log or stump into the hole to increase friction. (This is helpful, but not necessary.) Set the large end of the drill in the hole and put the socket atop the drill, holding it in your left hand and resting the left forearm on the bent left knee to steady your hand. Take the bow in your right hand and start moving it in steady, back-and-forth sweeps that are as long as the string will permit. (You must reverse these directions if left handed.)

Once begun, the motion must be maintained at a steady pace; and the pressure on the socket must be as high as you can make it without slowing the speed of the drill. As the drill spins, its lower end will generate a great deal of heat, and both the drill end and the surface of the hole will begin to blacken. Heat will continue to build up as the friction continues, and carbonized dust will spill through the notch onto the tinder below. When the friction area and the tinder pile are smoking, speed up the bow action, increase the pressure on the socket, or both. A few seconds of this and you should see an actual glow of fire in the blackened dust heaped on the tinder.

When you are certain that such a glow is real and not just a wishful thought, lay the bow and drill aside, move the fireboard, and pick up the chip or whatever with its load of tinder. Gently fold the tinder over and around the smoldering area and carefully blow on it or fan it into flame. Use it to light your prepared fuel.

This will work very well if all goes right, but you may die if it doesn't! *Carry matches and tinder!*

Another friction fire starter is the fire plough. Make a fireboard as before, but somewhat longer and with no notch or drill hole. Using a knife or a pointed rock, make a long, straight, longitudinal, shallow groove in the flattened area. This groove must be eight to twelve inches long and about half an inch deep, and it must run to the end of the fireboard. Select and shape a stick of one of the listed materials. It must be ten to twelve inches long and half an inch or more in diameter. Cut the small end at a near forty-five degree angle, round the large end, and cover it with a cloth pad to protect your hand.

To use, kneel on both knees with the fireboard clamped between the knees with the grooved end projecting forward. Grasp the plough in your left hand (if right handed) with the thumb and forefinger encircling it just below the pad. Cup the palm of the right hand over the pad and your left hand. Bearing down firmly with both hands, start sliding the beveled end of the plough back and forth in the groove with as much speed as you think you can maintain.

The sliding plough will generate enough heat to blacken and carbonize its own end and the surface of the groove. The toe will then begin to grind out a blackened powder and deposit it on tinder placed beneath the open end of the groove. Continued friction will produce sufficient heat to start a glowing spark in the dust.

Carefully add tiny shreds of tinder to this dust pile and carefully and gently fan or blow the fire to greater life. You can do this without moving from your position, and this enables you to resume the friction process without delay if you fail to achieve fire on your first attempt.

You can start a fire with an electrical spark if stranded by a broken-down or disabled gasoline-powered vehicle.

With a battery, simply touch a wire that leads from one battery post to a wire leading to the other post, or touch any hot wire to vehicle metal. *Do not short directly from post to post!* Batteries produce hydrogen gas, and you could touch off an explosion.

You can also use a spark plug or spark plug wire to generate sparks. Brace or block a wire so that it is nearly but not quite in touch with the vehicle metal. Lay the metal body of a spark plug in solid contact with such metal. With a magneto-fired or electronic ignition system, you must then turn on the ignition and crank the engine to produce sparks. With a distributor, you can remove the cap, pull the secondary (large) coil wire from its central turret, and hold the end of the wire near the metal. Remove the distributor rotor and work the ignition points by hand. Each time you open the points (with the ignition on), the wire will produce a tremendously hot spark. This will work even if the battery is too weak to crank the engine.

For tinder in such a situation, use a rag tied to a stiff wire or a slender wand. Dip it in the fuel tank to soak it with gasoline. Be careful when you light it, as it will light almost explosively. If you are planning to leave the car to set up camp, take some gasoline with you if at all possible, as you cannot find or devise any tinder as good.

A car's cigarette lighter will light anything flammable, and is almost as good as a match. Any fire lighted by one of these emergency methods will then have to be carried to your campsite if you leave the vehicle. Matches are still your best choice!

You can easily start a fire with a burning or magnifying glass when the sun is shining, and such glasses are easily improvised from binocular, camera, or telescopic sight lenses. A single lens reflex (SLR) camera can also be used. Open the back of the camera and remove the film, then turn the shutter

speed selection to the bulb setting. When you trip the shutter, it will remain open; and you can use the whole camera as a burning glass. Most SLR cameras have a lens that can be removed without damaging either camera or lens, however; and detaching the lens does not risk damaging the film.

It is also possible to cut a piece of crystal-clear ice to proper shape (flat or concave on one side, strongly convex on the other), and to polish it by melting or smoothing with the hands. The sun in winter is so low in the sky that the lens must be held far to one side of the tinder, and any melt water produced by your "glass" will not drip on that tinder.

The problem with depending on a burning glass is that the sun is seldom shining when you most need fire. A burning glass will help you conserve your matches, but is no real substitute for them. *Carry matches and tinder!*

You can actually start a fire with two flashlight batteries and a steel wool pad, such as the Brillo pad you might carry to clean cooking gear. Hold the two batteries firmly in series, just as they fit in a flashlight. Tease a thin strip of steel wool by pulling gently. Hold one end of the strip firmly against the base of the bottom battery and stroke the other end against the top battery post. When a spark glows brightly, blow briskly on it to give it much greater life. The spark will expand to a red-hot mass that will give off intense heat. This will not last long, but long enough to enable you to light a prepared fire stack with it.

Each of these emergency means of starting fires will work when conditions are exactly right, but none is certain to work when you most need fire. It is often very difficult to build a fire in stormy situations, even with adequate tinder and matches. Try each of these methods of fire starting in your own back yard when the weather is bad, so you can retreat to safety when they fail to work. You will then never

again venture afield without more certain means of starting fires! *Always carry matches!*

As with matches, so it is with tinder. You can find usable tinder of many kinds in summer when everything is dry. You might also find some in winter; but you might not. Unless you are in paperbark birch country, you are most unlikely to find any when you need it and when you have neither the time nor the energy to waste searching for it. Having a supply of instantly available tinder in a pocket or emergency kit might then spell the difference between life and death. *Carry tinder!*

If you have no prepared tinder and everything is covered with snow or is dripping wet, don't give up. There are always a few places where dry materials can be found. Packrat and woodrat nests may look like ungainly mounds of twigs, cones, and other forest debris dumped haphazardly, but the lower parts of these mounds are always dry. Somewhere near the center of the dry area is a nest of dried grass or other soft, fibrous material, and this is highly flammable. You are also likely to find a goodly store of nuts, seeds, or other such food secreted in a snug pantry chamber.

Other spots likely to produce dry tinder in all weathers are burned or rotted hollows in the base of trees, the undersides of partially rotted or burned logs where these are free of contact with the ground, conifer needles or deciduous leaves where these have been protected by an overhanging ledge, and the inner surfaces of hollow logs. It is also possible to find "fat pine" or pitchy wood in stumps, logs, or the knots of rotted logs.

It is vitally important that you not attempt to start a fire until the fuel necessary to maintain that fire has been assembled. You often see would-be outdoor types assemble the necessary tinder, ignite it by whatever means, and only then

begin a frantic search for fuel. All too often the fire expires before the fuel is found and brought to it. Always make it a point to have everything in readiness before striking a match or making any further attempt to ignite the tinder. The sole exception to this would be when you need to use tinder alone to warm cold-numbed hands.

The *Boy Scout Handbook* and most books on outdoor skills list a number of different types of "fire lay." The most useful of these, in my opinion, for warming fires or for starting fires in bad weather is the "teepee lay." The kindling is stacked in teepee fashion with an opening on one side, and the tinder is placed inside. Larger and larger pieces of fuel are leaned around the outside. When the tinder is ignited, the flames rise up through the narrowing cone; and the teepee walls both protect against drafts and reflect the heat back and forth, just as in a furnace combustion chamber. Once the fire has reached respectable size, you can lean damp or green wood against the stack to be dried and to form a heat reflector.

Whatever the tinder and the means of ignition, and no matter what fire lay you choose, a blowpipe will be of help. This can be anything from a soda straw to a large grass or weed stem, but you can also use the rubber tubing from your emergency kit. I use a four-inch piece of quarter-inch copper tubing, flattened on one end, on the fire end of this rubber blowpipe. By blowing through such a tube, you can concentrate oxygen exactly where it is needed and can nicely regulate the force at the point of delivery. This is especially valuable when blowing a spark into a flame. Another advantage to using a blowpipe is that you can keep your face well out of the smoke.

The well-prepared user of the outdoors should also know more about fires than simply how to start them.

Chapter XI

Fire Know-How

You must not build your fire where snow from a tree, a bank, or an overhanging ledge can fall or slide to bury it, or where its heat will cause melt water to drip on or run under it at any volume. A little dripping is sometimes unavoidable and will do no damage if the fire is of a good size before the melting starts.

It is nearly impossible to build a fire on a really wet surface, and this is especially so if this is an absorbent material such as dirt or wood. If you have a piece of foil in your emergency kit (and you should!), spread this over the wet surface. The foil will both reflect heat upward through the wood of the fire stack and prevent steam from rising through that stack. If you have no foil, use the driest and least absorbent material you can find for a base.

A fire built directly on snow or ice will quickly melt its way down and drown itself in the melt water produced. Build a fire on a rock or stump that projects above snow level if possible, or make a platform of green or dry logs or bark covered with dirt. Do not use a layer of small rocks, as these will heat quickly and melt their way down. If the ground is bare but frozen, make a platform of either green or dry wood and build the fire on this. The wood will be wetted by the thawing ground and will not burn until both it and the ground under it are dry.

Wood burns only when it is heated to its kindling point, and this differs with each kind of wood and with its condition.

Moisture in or on the wood serves both to raise the kindling point and to absorb and carry off much of the heat you are trying to concentrate on that wood. It matters not whether this moisture is sap naturally contained in green wood or is water absorbed by dead wood. Damp or green wood is useful only on a very hot fire or when used to keep a fire burning slowly over an extended time. Ash, birch, cassiope, and certain other species of trees and shrubs burn as well when green as when dry; but these are exceptions to the norm.

Use standing dead wood and the dead limbs that grow from the bottoms of evergreen trees when you can. The bark from most dead evergreen trees and logs makes splendid fuel once you have a good fire going, but it is not good for starting fires. The thin, hard bark from dead hemlock or from white fir logs is almost as good as charcoal for producing a lot of heat and little flame; and the thicker bark from Douglas fir has actually been used in place of charcoal in forges.

It does little good to list the comparative values of different trees or shrubs for fuel. You will have to make do with those found in your area. Suffice it to say that most hardwoods burn hotter and produce more lasting coals than most softwoods (these are botanical terms and do not denote actual texture or density of wood); that resinous softwoods such as pines, firs, Douglas fir, etc., produce more soot and throw more sparks than other woods; and that the slower-growing and harder the wood, the better it normally is for fuel.

Sagebrush, chaparral, and greasewood found in arid areas of the West make splendid fuel, but the fire must be kept tiny if one person is to keep it supplied with fuel. The sagebrush is one of those woods that "keep one man chopping, two men toting, and one man stoking" to keep a good-sized fire going. Most other brushwood is nearly as bad, for the small-diameter pieces of dry hardwood burn very rapidly.

The easiest way to collect wood for fuel is to gather "squaw wood." This consists of dead limbs attached to standing trees or downed logs and of whatever bark, small logs, limbs, wood chunks, or other burnable wood product that is both readily at hand and obtainable without the use of tools. Remember that wood that has been lying directly on the ground is probably damp, at least in all but mid-summer.

Do not waste energy by trying to break limbs or poles into burnable lengths if your fire is built outside a shelter where space is no problem. Instead, lay the pole or limb across the fire so that it will be burned into two pieces, repeating as necessary. An alternative to this is the so-called "Indian fire." In this method, poles are placed with one end in the fire and with the other pointing outward, the outward ends radiating to form a half or three-quarter circle. The missing quadrant allows access. These poles are then shoved inward as the tips burn off.

It is often possible to build a fire against a large stump or log that will itself burn, and by judicious use of smaller fuel to keep this burning for several days. If you use your shelter only at night, such a fire can be the center of your daytime activities, and it can serve to keep a fire going while you are out checking traps, building signals, and so forth.

Animal dung (from grass eaters), twisted grass, peat moss, dry cattail leaves—are all burnable. Animal fat makes a usable fuel, too, although use of it can make a camp smell like Dogpatch's Skonk Rendering Works! You can burn this fat by placing it in a shallow container with a wick (a slush lamp) or by draping thin strips over a pyramid of bones or an open fretwork of rocks and building a hot fire under this. The melted fat will run down over the bones or rocks and will burn, producing some heat, a great deal of sputtering, and still more stench.

A fire for cooking and a fire for heating a shelter should both be as small as they can be and still accomplish their purpose. Do not build a roaring bonfire unless you are on the verge of hypothermia and need to develop a great deal of heat in the shortest possible time or unless you are using the fire as a signal. Such fires are wasteful both of fuel and the energy used to gather it. Some long-ago Indian is reported to have said, "White man build heap big fire, stand way back. Injun build small fire, get heap close." The Indian was the wiser man; emulate him!

A rock-lined firepit will help both to contain a fire and to concentrate the heat where it is most needed or wanted. *Do not use streambed or other wet-area rocks to build this!* You can make all sorts of arrangements for cooking over this, can use one end for a fireless cooker, and can bank live coals under a heavy blanket of ashes to preserve fire-starting coals for a considerable time.

The coastal Indians of the Pacific Northwest used cedar bark torches to light their cabins and maintain fire over a long period of time. Bark from cypress, juniper, yew, sagebrush, and cliffrose will work as well; and grasses, peat moss, tree moss, and other similar material can be used. The Indians used finely shredded or pounded cedar bark as the central core of the torch, surrounding this with parallel splints to form a tube, and wrapping this with thinner bark laid in overlapping, helically-wound layers. When the shredded bark was lit, it would burn with a low, flickering flame that would last for twenty-four to forty-eight hours, depending upon the size of the torch. Most were made in a diameter of four to six inches, were from two to more than four feet long, and weighed as much as fifty pounds. Such a torch is too heavy to be easily portable.

Another traditional way of preserving fire over a long period is by the use of punk. This can be fluffy rotted wood,

the dried pith of weeds or shrubs, dried or powdered manure, or the dust left by wood-boring insects. To use punk, you must burn it in a tightly enclosed space, allowing just enough air to keep the fire slowly smoldering. A hollow bone, a seashell, or even a hollow piece of wood will work; but you'll have to line the wood with mud to keep it from burning. You can even mold a hollow ball out of mud, then cradle this in a sling made of cloth, woven vegetation, or animal skin for carrying or hanging.

Another way to preserve your fire-making ability is to take steps to protect an ample supply of dry wood and kindling. *Do not neglect this!* Nothing can be more discouraging and disheartening than to wake to find the immediate environment, including all available fuel, has been sheathed in a layer of ice by a freezing rain or is buried under a fresh blanket of snow. A supply of dry wood and of bone-dry prepared tinder and kindling can then literally be a lifesaver.

Use a sled to transport fuel whenever possible, as this uses less energy than carrying it. When you have exhausted the readily available fuel within the area, move the camp to a new supply rather than transport the fuel to your existing camp. Do not build a too-elaborate camp at the new location if the fuel supply there is again inadequate for an extended stay.

You must not build a fire where the fire or its coals can fall or slide into contact with your bedding, your clothing, or any part of your shelter if this is constructed of flammable materials. Everyone knows how flammable dry grasses, dead leaves, or dry pine needles are. Few seem to know that evergreen boughs are also highly flammable after several days of drying and become almost explosively so after a week or two. Fire is the largest single cause of injury in wintertime camping, and an emergency camp is no less vulnerable than a recreational one. Be extremely careful unless

your shelter is constructed of flameproof or hard-to-ignite materials.

Carbon monoxide is an ever-present and deadly threat whenever a fire burns in an enclosed area! The gas is produced when a fire is deprived of sufficient oxygen or is smothered in its own by-products. It is prevented by adequate ventilation. *Let fresh air in; let smoke out!*

Carbon monoxide (CO) is colorless, odorless, tasteless, and non-irritating, and cannot be detected by human senses. Its victims normally remain unaware of the threat until they are helpless, unable to take any remedial action. Indeed, most victims die without a struggle, without ever realizing that a problem exists.

The CO molecules combine with hemoglobin, the oxygen transporter of the blood, in the exact same proportion as would oxygen. (Actually, the hemoglobin shows a distinct preference for the carbon monoxide, choosing it over equally available oxygen.) This creates a stable compound known as carboxyhemoglobin, and this compound causes the bright-red blood and the dark-red skin color that is diagnostic in its victims. The effect is cumulative and death results when a total of one and a half quarts of the pure gas has been inhaled in a brief period. Lesser amounts can cause severe and lasting brain damage.

Take no chances with this insidious killer! Maintain adequate ventilation at all times. If in doubt, over-ventilate. It is much better to be chilled than killed! If you even suspect that the shelter atmosphere has become dangerous, get outside, fast! Breathe deeply of fresh, clean air for a period of not less than fifteen minutes. When you feel completely alert, take steps to purge the shelter of its noxious atmosphere and to improve the ventilation. Most of this work can be done from outside the shelter.

Chapter XII

Dehydration

The need for water is greatest when the air is very dry and the ambient temperature is high, but you must have water even in the wettest and coldest of weather. You lose water every time you exhale (dry air in, moist air out); moisture is lost through the skin even when you aren't sweating (insensible perspiration); and approximately one and a half quarts are excreted on a daily basis. The total daily loss amounts to a minimum of two and a half quarts, and this loss is greatly increased by high temperatures and exertion.

The body manufactures a quart or so of water by digesting food, but this still leaves a daily deficit of one to one and a half quarts that must be made up by drinking fluids or by eating water-containing foods. These amounts will suffice only if you stay out of the direct sunlight and stay as quiet and relaxed as you can. Failure to supply these demands will bring on dehydration. Wind will hasten its onset by speeding evaporation.

The earliest sign of dehydration is an intense and growing thirst, caused by a drying of the inner surfaces of the mouth and throat. The discomfort of this can be somewhat to largely alleviated by holding a small pebble or even a button in the mouth or by chewing gum. You can also reduce the drying of these surfaces by keeping the mouth closed. These expedients will relieve the symptoms but will do nothing to eliminate the underlying cause.

If ambient temperatures are high or if you are exerting yourself, your body must rid itself of the heat being absorbed or generated. The external veins will dilate so excess heat can be exchanged with the atmosphere. If air temperature is above 99 degrees Fahrenheit (body temperature is 98.6 degrees), no heat can be exchanged and body temperature will rise. When internal body temperature rises to 99 degrees, you will begin to perspire profusely. This is an effort by the body to cool itself by evaporation, and it is highly effective when the air is very dry or when the wind is blowing. The problem is that this mechanism is venting water to the atmosphere and increasing dehydration.

If internal temperature still continues to rise, your heart will accelerate and the rate of perspiration will increase. Your face will become flushed, your pulse rate will become rapid and erratic, and your breathing will become labored and harsh. Unless the lost water is then replaced, you will begin to make silly and irrational decisions, just as in hypothermia.

The water contained within the cells will begin to migrate through the cell walls to the area between the cells and all bodily processes will begin to slow down. The blood will begin to thicken and the kidneys will attempt to compensate for the lack of water by concentrating the urine, which will become very thick and cloudy. Water will be withdrawn from the contents of the stomach and intestines and all digestive functions will cease. Toxic by-products of life processes will accumulate.

If the lost water is still not replaced, you will become dizzy and begin to lose muscular control, and you will become nauseated. Vomiting, if successful, will increase water loss. You will then be very close to heat exhaustion and death, and the danger of a heart attack will be very real. You will have almost reached the point of no return, where

you become unable to help yourself in any way. *If the body is not then cooled and the lost water replaced, you will soon die!*

It is possible to reach this point in one day! The air temperature of many of the drier parts of our continent regularly reaches between one hundred and one hundred and ten degrees in summer, and much higher temperatures are sometimes encountered. These temperatures are recorded in the shade, and it is much hotter in direct sunlight. An egg will fry on a rock under such conditions!

Water loss can be held to a minimum if you seek shelter from the sun and heat during the hottest part of the day. Take a lesson from the Arabs, who keep themselves fully covered with loose-fitting clothing to prevent both sunburn and evaporation of skin moisture. The shade of a rock, a bush, or a cutbank is often adequate as shelter, but you can make a parasol of brush, cloth, or grass if you must.

When stranded by a stalled or stuck vehicle and no shade is available within reachable distance, use the car as shade. The shadow under the car will be total, and the roof and seats will prevent the floor of the car from becoming hot enough to radiate significant heat. Open all windows and doors and the hood and the trunk lid to allow for maximum air circulation, then get under the car if you can.

You can increase clearance by either removing dirt to make a trench or by jacking the car up. If you use a jack, do not then get under the car without securely blocking the car in raised position, using a spare tire, rocks, mounded dirt, or anything else solid enough to keep the car from crushing you if the jack is displaced. If you cannot create enough clearance, stay on the shady side of the car. *Never stay in the car itself!* The air in the car will be much hotter than the air outside, even with the windows and doors open.

The temperature at the surface of the ground is much hotter than the temperature a foot below it, and the bottom of a two-foot-deep trench will be as much as fifty degrees cooler. Dig a trench in an east-west direction and heap the sand or dirt along the south side. Use a hub cap to dig a trench if stranded by a car. Do not attempt to dig during the heat of the day or under direct sunlight, as the extra heat caused by the exertion might well be enough to cause prostration and death. Instead, dig the trench well after sundown or before sunup and only when the dirt or sand is loose and easy to move. In sand, of course, you must be alert to the danger of a cave-in.

If lost or stranded, be sure to leave a conspicuous marker of some kind in a prominent place near your ditch! If you neglect this, a searcher might pass near by without either of you knowing the other is near.

Do not eat during periods of critical water shortage, as the food will absorb water from the system and will not be digested in any case. Make an exception to this rule for foods such as soups or canned foods with a high water content.

Do not attempt to severely ration a limited supply of water. Water in the canteen does not prevent dehydration. Only water taken into the body can do that. Many persons have died of dehydration with water still in their canteens! Use water sparingly, but drink what you need when you need it. Your life will not depend solely on rationing water, but upon being found, making your way out, or finding water.

The body of an average man, weighing approximately one hundred fifty pounds, contains about ninety pounds of water. You must lose only slightly more than one tenth of your total water to die of dehydration, and for this man this amounts to only a little more than a gallon! The normal daily water deficit, with neither high temperatures nor exces-

sive sweating, is about one and a half quarts; and if you do not manufacture water by the digestion of food, it is about two and a half quarts! The difference between the actual and the maximum sustainable loss represents your margin of survival, and you must make every effort to prevent excessive loss.

You must also replace that basic loss and make up that deficit by consuming at least that amount of water daily.

Chapter XIII

Water

You will have little trouble finding safe water in the mountains in winter and spring. You may find water in the summer or fall as well, but you will generally not know whether or not that water is fit to drink. Water is seldom poisonous, but it may be so grossly polluted as to be just as dangerous; and it is often so full of minerals that it causes severe digestive upset to those not accustomed to it. Some waters harbor harmful parasites. Water found in desert country is almost always of doubtful quality, quite regardless of season.

Never drink water if you are doubtful of its purity! This must be understood to apply with equal force to the use of water in any way that might allow it to enter your body. Don't use it to wash your hands before handling food unless that food is to be thoroughly cooked. Don't use it to wash dishes or cooking utensils unless those are to then be immersed in boiling water for several minutes, not just wiped dry. Don't use it for making tea or coffee unless you allow it to cook at a rolling boil for at least five minutes. Improper use of impure water may make you gravely ill, may cause your death directly, or may render you helpless so you may die of other and unrelated causes. *If in doubt, purify!*

Make germ-polluted or parasite-infested water safe by boiling it for at least five minutes (at really high altitudes, boiling will not reliably purify water unless a pressure cooker is used; but water found there is less likely to be contam-

inated), by the use of halzone or iodine tablets, or by distillation. Of these methods, only distillation will significantly change the mineral content of the water.

When using halzone or iodine tablets, follow the directions on the label. Double the number of tablets, the time before drinking, or both if the water is obviously polluted. Two drops of tincture of iodine will replace one iodine tablet. When using such chemicals to purify water, make sure to wet all parts that may come into contact with either the water or the mouth (canteen cap, threads, cup, etc.) with the treated water and do not then use for the prescribed time.

You can completely purify water with a solar still. Such a still will even "create" water by extracting it from seemingly dry soils. You need a square of transparent, wettable plastic film such as polylethylene to make a still. You should have such a piece in your emergency kit. It folds almost as small as a cigarette package and weighs little more, yet has a hundred uses. Use it as a windbreak, a waterproof lean-to, a blanket, a water catcher, a shelter liner, a ground sheet, or even as an emergency poncho or raincoat. Its greatest potential value, however, is as a solar still that will either supply water where no water exists or purify and demineralize bad water.

Dig a conical hole about eighteen inches deep and three feet or so in diameter. The site should be in the lowest spot available, as that is most likely to be damp. The sandy or muddy bottom of a recently dried up watercourse or pond is ideal. Place a catchment container in the bottom center of this hole, or line a bowl-shaped depression with plastic if you have no container. Place one end of the surgical tubing from your emergency kit in the container and anchor the other end well out of the pit. Lay the plastic sheet loosely over the pit, then push the center down to form a cone-shaped depression with its bottom just above the container. Weight the

edges with dirt and rocks to make an airtight seal. Place a fist-sized smooth rock in the center of the cone to keep the plastic stretched tight. This cone will also trap small mammals and lizards. (See Figure 9.)

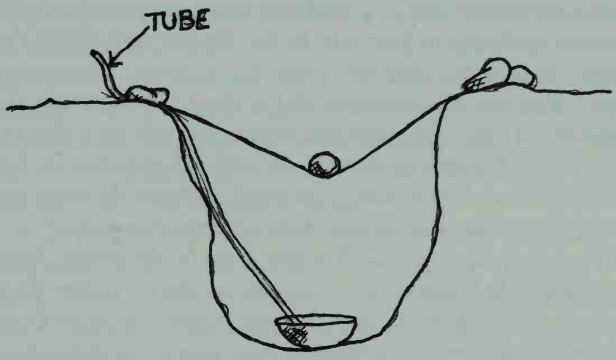

Figure 9: Solar still

The sun shining through the transparent plastic will heat the air beneath it by its greenhouse effect, and this superheated air will suck moisture from the soil. As the then moist and heated air comes in contact with the cooler plastic film, it will deposit part of its moisture in a fine layer of condensation. With a wettable surface, this condensate will run down the plastic and drip from the point of the cone into the waiting container.

It takes from one to as many as three hours for a still to begin producing water, this depending on the angle of the sun, the temperature of the air, and the amount of moisture in the soil. Each time you break into the still to procure its collected water, you break the seal; and all of the super-

heated atmosphere escapes. It will then take nearly as long for the still to resume production as it took to first start it. With a tube running from the container to a point outside the still, you can suck water from it without in any way disturbing the seal.

One such still will produce several pints of water a day from a seemingly dry soil, and you can greatly increase this amount by lining or partially filling the pit with chunks of cactus, succulent, nontoxic weeds, or green grasses and leaves. You can even soak the soil of the pit with poisonous, polluted, or highly mineralized water, and will then recover pure distilled water in almost the original volume. *Do not allow even one drop of dangerous water to touch the inner surface of the plastic or the inside of the catchment container!*

Do not attempt to distill water from body wastes, from car radiator or battery water, or from unknown plants. Each of these either does or may contain poisonous or harmful substances that are more volatile than water, and distillation would only concentrate these substances.

If you have no plastic but need to purify poisonous or mineralized water, you can do so by boiling the water and collecting the steam. Boil the water by fencing off or digging a small pool if you have no pot. Dump enough hot rocks (do not heat rocks that have been in or near the water!) in it to bring it to a boil. Cover your "pot" with a thick pad of cloth, dry grass, or any other absorbent and nontoxic material held well clear of the water. As this material collects steam, wring it into a container or into your mouth.

Water is polluted by animals, by man, and by decay of vegetation, but only pollution by man and, to a lesser extent, by animals is dangerous. An exception to this is any species of water hemlock, *Cicuta,* which can actually poison animals or men when its underwater parts are injured as by livestock trampling and release their toxins to the water. Rotting plant

material will discolor water and will render that water more or less distasteful and malodorous, but it will not ordinarily make the water unsafe for use.

If the water is unpleasantly colored or strong smelling, you can largely eliminate these objectional qualities by filtering the water through layers of charcoal. Pick out the blackest chunks of charcoal from a campfire and use these. *Do not use ashes!* Water and ashes together make lye, a strong caustic solution. You can strain out large particles or organisms by making a cone-shaped filter of grass or similar vegetation, or by filtering the water through a layer of sand. *None of these makeshifts will purify germ-polluted water or significantly affect its mineral content!*

Rain is distilled water and is perfectly safe to use *if the catchment surface or container is not contaminated.* Snow is also distilled water and is safe to use if not visibly contaminated. Crusty or long-compacted snow contains much more water by volume than fresh or fluffy snow. Do not eat snow when low on food or when body heat conditions are marginal because of its chilling effect. Melt it instead and take the chill off the resulting water. Snow makes water available throughout the area of the snowfall and ends all questions of water purity until the last drift has melted.

When melting snow for water, do not put fluffy snow into a pot and place this over high heat, as you can actually scorch the pot! Put a small quantity of snow in the pot and place this near but not on the fire. When the pot's bottom is covered with liquid water, you can then fill it with snow and expose it to direct flame.

Ice normally contains every impurity that was in the water before it froze, although sea ice tends to lose salt as it ages. If you have ever nibbled or sucked on an icicle after breaking it from the eaves of a house, you have noticed the distinct flavor of tar that permeates it. That this flavor may

have owed some of its tang to bird droppings and other such exotic elements never seemed to perturb me or my compatriots when I was a child. Ice, like snow, should not be used to quench thirst. Melt, heat, and treat as you would water from the same source.

Many cacti contain juices that can be squeezed or sucked from the pulp, but this is by no means the equivalent of spring water! No cactus is toxic, but taste ranges from almost good to nauseating. Most cactus plants dehydrate to some extent in continued drought conditions, too, and this source is vastly overrated in most books. Don't count on finding sufficient water to supply your needs by chopping up cactus in summer or early fall unless you are using a solar still to extract it. Cactus plants from a low, damp area will be both extremely large and very succulent; and they will indeed yield useful quantities of glue-like juice that will sustain life. I have no experience with *Bisnagas*, the several types of barrel cactus, which are most often cited as emergency sources of water.

You are often told how to extract water from grapevines, but you are never told how limited is the range of wild grapes or how unlikely you are to find them in arid or waterless areas. The only advantage grapevines offer is that the juice is perfectly safe to use even when all of the surface water is contaminated, stagnant, or highly mineralized. Extract the juice by cutting a deep notch in a thick vine as high up as you can reach. When you then sever the vine at ground level, all of the sap in the section below the notch will drain out. Stand the cut ends of several such sections in a trough of bark and put your container under the low end. An alternate method in spring is to cut off the tips of some of the new canes and bring the cut ends into a bundle above your container. This is less destructive of the vines than cutting the older trunks.

The body fluids of temperate zone fish are drinkable, but this source will be of use to you only if stranded on a boat or island surrounded by salt water. Even then, if the means were at hand, distillation of the salt water would be a better choice than using the juices of raw fish. If you have to use such juices, put pieces of cut fish into a shirt sleeve or a pant leg and wring it as tightly as you can.

You are often told how to locate water by digging. You must not try this unless you find a spot that is very damp or wet or find an obvious catchment basin in the bottom of a recently dried up watercourse. If such spots are sandy and are very damp or wet within a foot of the surface, then water will be found within two or three feet. In gravel, the water is far more apt to be at a depth of ten feet than two, and digging to such a depth, especially without tools, would probably kill you from increased water loss long before you reached it.

Bees of any kind (this includes yellow jackets, hornets, and wasps) indicate nearby water, usually within less than a mile. To find their source of water, "line" the bees, just as you would to find a honey tree. Simply follow the flight of a bee as long as you can, then go to the spot where you last saw it and repeat the process with the next bee. If the bee is flying a straight course rather than bumbling about in apparent aimlessness, it is flying either to its nest or to water. If you find the hive instead of water, simply line the largest number of outbound bees to find their waterhole.

Deer, antelope, cattle, wild horses, and other large animals must have water to live, and in hot weather these animals like to drink every day. Fortunately for the waterless survivor, these animals are all creatures of habit, tending to follow definite trails as they go to or return from their watering places. These trails will merge into larger and larger trails as they near water, and the junctions will be **Y**-shaped, just

as with roads. Again as with roads, the main stem will be the way to go; for the trails branch as the animals go away from water and come together as they go to water.

Quail and chukar indicate water within a mile or two. In some cases this water will be a "guzzler" provided by the wildlife agency of the state or province. These underground tanks or cisterns are fed by a catchment apron and so arranged that the birds can reach the water but large animals cannot.

Small desert-dwelling animals from mice to jackrabbits do not need water to survive, and their presence does not indicate water. These plant-eating animals manufacture water by digesting the carbohydrates they use as food, and the small carnivores that prey on them get all necessary fluids by eating their flesh and drinking their blood. That blood is a useful substitute for water for you as well.

Watch the weather! Desert areas are sometimes drenched by torrential thunder showers, and you can often see such storms for many miles. *Stay out of deep gullies or canyons when such storms are visible!* A storm miles away can fill such depressions in a matter of minutes, and nothing could be more ridiculous than to drown while seeking water!

If it looks as as if it might rain in your area, prepare some means of catching water. Lay out a sheet of plastic or other material to make a pool or a trough to channel water into any containers you have. Dam a gully with dirt to hold runoff water. Knot a shirt around a rock or a tree trunk in such fashion that water running down the trunk will drip from one point only. Lay out cloth to be soaked so you can wring it over a container. Don't wait until the rain starts to make your preparations. Desert storms are soon over and desert soil is thirsty. Have everything in readiness when the first drops fall.

Water tends to flow downhill, of course, and in doing so it cuts and carves the hardest rock. That distant thunderstorm will have filled numerous depressions if in rocky country, and some of these "tanks" will retain water for days or even weeks. In such cases, it is wise to ignore the usual rule for finding water and to even go uphill to the area of the storm.

Nights are usually cool to actually cold in the desert, even in midsummer, and the metal surfaces of a car, some rocks, and smooth-surfaced vegetation such as grasses become chilled to the dewpoint on some occasions. You can collect this moisture by wiping it off these surfaces (you should have wiped them clean earlier) or by mopping it off the grass. To mop efficiently, tie floppy rags or twisted bundles of dry grass around your feet and shuffle through the grass to saturate the material. Wring the water into a container. Continue until the sun has risen and the dew has largely evaporated.

Conspicuous green vegetation in an otherwise arid landscape is almost a sure sign of water either on or very close to the surface. Very large cottonwood trees in such areas are certain indicators of water. Greasewood is much greener than sagebrush but is not as vivid a green as cottonwood, and it only indicates alkaline water fairly close to the surface. A twisting line of green vegetation along a canyon floor indicates a stream course, but the vegetation will continue to thrive after surface water has dried up. Following such streambeds for any considerable distance downstream will usually lead to small pools or to still wet places where water can be obtained with a minimum of digging or with a solar still.

The tailings or abandoned buildings of worked-out mines normally (but not invariably) indicate water, either in the tunnels themselves or somewhere nearby. The water will

often be so full of drowned insects, lizards, snakes, and small mammals as to be undrinkable, but it will still be wet; and you can purify it by one of the methods described. A search of such sites will often turn up bottles or other usable containers that can be used to carry a supply of water if you choose to take the mine access road.

Be in no hurry to do so! If in desert or largely waterless country, it is not always wise to leave a water source you have found. You can obviously be rescued from that spot as easily as from any other, and you are far more likely to survive to be rescued if you remain by a dependable water supply. In addition to the water itself, such spots also provide a source of food, as both plants and animals will be more concentrated there.

When you find or reach a plentiful supply of water after a period of dehydration, do not drink all the water you want immediately. Stop after a few sips, wait for a time, then sip some more. Too-rapid intake of water will cause violent nausea, and in some cases will bring on what amounts to a severe case of heat prostration.

It takes hours or even days for the contents of the stomach and intestines to absorb enough water for normal function to resume, and you should not be alarmed by a temporary lack of bowel activity. Indeed, it is often found that attempted bowel movement during the first twenty-four to thirty-six hours results in the passage of large quantities of almost-clear water. Do not take medicines or laxatives, as the problem will cure itself when the water balance of the body is fully restored.

Do not camp at the waterhole! Animals and birds of the area will be totally dependent upon its water, and your presence there would deprive them of access to it. Camp some distance away.

Chapter XIV

Basic Food Needs

You will not die of starvation for a very long time even if you do not eat at all. The body at rest, in warm surroundings, uses energy at a low rate. It has been determined that a man of average size, weighing approximately one hundred fifty pounds, requires about fourteen hundred calories a day to maintain his bodily functions. To these must be added those calories required to provide the energy for whatever activities he performs and to offset heat loss caused by low temperatures.

[It must be noted that the term "calorie" as used in nutrition refers to the large calorie or kilocalorie, which is equal to one thousand small calories. A kilocalorie is the amount of heat required to raise the temperature of one kilogram (2.2 pounds) of water by one degree Centigrade.]

The total daily requirement at moderate temperatures is about sixteen calories for each pound of body weight at a low level of activity, increasing to twenty-one for moderate activity, and twenty-five for strenuous activity or hard work. Low temperatures or poor protection from the weather will vastly increase these requirements.

If less than the required amount of calories is consumed as food, the deficit will be made up by the consumption of fat and protein from the body itself. This catabolism (autocannibalism) will continue until almost all of the fat and more than half of the protein has been consumed, at which time death from starvation will occur. During this period,

the body will grow progressively weaker as protein is withdrawn from the muscles, but this weakening results in lessened activity and a correspondingly lowered demand for energy. Also, each pound of weight lost reduces energy demand.

If this same one-hundred-fifty-pound man referred to earlier is in reasonably good condition, his body will contain approximately twenty-eight pounds each of fat and protein. (Most people have at least some excess fat, and their health will actually improve during the first two or three days without food!) Each ounce of fat will produce about two hundred sixty calories when catabolized, so the twenty-eight pounds of fat would provide needed energy for more than thirty days of moderate activity. Each ounce of protein yields one hundred fifteen calories, so half of his total protein would keep him going for another five or six days.

These figures are approximations only, and can vary by as much as five percent plus or minus, even in the same person. Then, too, metabolisms are different, and no two people will operate these mechanisms with the same efficiency. The somewhat overweight person would have a distinct advantage over a thinner, more muscular one. These figures prove, however, that the average human body can subsist on its own reserves, with no food intake at all, for nearly forty days if those reserves are not squandered by reckless expenditures of energy.

When seeking food, then, you must first of all determine whether the possible gain in calories exceeds the amount of energy you must expend to get it. An additional factor in this equation is the very real psychological advantage of having a full stomach. A good mental attitude is vital to long-term survival, and constant, unsatisfied hunger is destructive to this.

Emergency food supplies are available from two sources: animal life and plants.

Chapter XV

Food from Animals

Forget food and taste preferences! Forget the code of fair chase! Eat anything you know to be edible and take food birds, animals, and other creatures by any and all means available. Don't wait until you are weakened by hunger and in poor physical shape before giving up the luxury of being squeamish or selective in what you eat and how to get it.

Any mammal or bird found on the North American continent is edible in all of its parts, with the exception of the livers of polar bears, some seals, and all canines. These livers are toxic because of excessive vitamin A content. The skins of some frogs, toads, and salamanders are toxic because of toxin-filled glands. The heads of poisonous lizards and snakes are also dangerously toxic. Some Pacific shellfish are toxic because of organisms they ingest at certain times. With these exceptions, you can safely eat all of the parts of any amphibian, mammal, bird, fish, reptile, or crustacean you can catch, club, shoot, snare, or trap. You can also eat many insects, but not all.

Animal flesh is generally the most nutritious food you are likely to find, and the flesh you are most likely to secure is that of one of the rabbits or hares. These animals are almost universal in distribution, do not hibernate, and are so predictable in their habits, so lacking in common sense, that they are easily trapped or snared. Their meat is very tasty in most cases (some taste rather strongly of sage), and is nutri-

tious as well; but it must be supplemented with edible fat from other sources.

You can starve to death on a diet of lean meat alone! You can eat all you can hold of rabbit meat or winter-poor venison, yet still die of starvation! An exclusive diet of lean meat will soon cause a severe diarrhea that will quickly drain your energy. You can live for forty days or more with no food intake, but you are not likely to live half that long on lean meat alone. *You must have fat in your diet!*

You can obtain edible fat from insects, from most animals and birds, and from seeds and nuts. Bone marrow is a very rich source. Crack the larger bones to get the marrow, then cook only as much as you must to make it edible. Crush and boil smaller bones to extract the fat. Even large bones left by predators in cold weather are valuable if not too old. Crush these between rocks and boil the fragments to extract nourishment and to kill harmful organisms. Use as soup.

Cicadas, crickets, dragonflies, grasshoppers, katydids, and locusts are considered delicacies in North Africa, the Middle East, and Asia. Do not waste time and energy by chasing such flying or hopping insects, but, instead, look for them on grass blades or other vegetation immediately after dawn, when they are still sluggish or torpid from the chill of night. Earthworms, caterpillars (don't use brightly colored caterpillars), and even ants and termites are edible, as are periwinkles, helgramites, and other nymphs found in water. None of these will be available in winter.

With the large hopping or flying insects, remove the saw-toothed portion of the legs and the harsh, membraneous wings. You can then thread them on a wire and toast them over coals, or bake, boil, fry, or roast them on hot rocks. The caterpillars and worms can be cooked directly in hot ashes or by boiling. This is a food source you are unlikely to exploit except in real emergency, but some people find them

tasty, and they are real life savers. Most such insects contain more than 50 percent fat! Bears remain fat and healthy on a diet made up largely of insects (mostly ants and termites), and you can do the same.

A large caliber or high-velocity bullet will completely destroy a grouse-sized bird or a squirrel-sized animal, leaving little or nothing that is edible. Unless you have a bow, a .22 rifle or pistol, or a pellet gun, the best way to secure such animals and birds for the pot is to use deadfalls, snares, or traps.

These devices can be made in almost endless variety, but the ones listed and described here are the best of those that can be made with only a knife or hatchet as tools. If you have neither of these, don't give up. Sticks can be cut with sharp-edged rocks, and notches (when needed) can be worn or ground rather than whittled or carved. Snares will require wire or cord, but even a bootlace will serve in a pinch. Once you have captured the first animal, you can use instestines, strips of skin, or sinews and tendons for cord. You can also make usable cords out of vegetation as explained in Chapter 21.

Box traps are widely used for pot animals and birds, but should not be used for animals likely to dig or gnaw their way out unless you plan to wait nearby. Make such boxes by stacking notched sticks in log-cabin style, vertically to make a square-sided box, or with every layer or second layer indented to make an A-frame or a square-based pyramid. Place a heavy weight on top to hold the sticks tightly locked together.

To make such boxes portable, lay a stick across the top logs and tie its ends to the bottom logs. This will form a convenient carrying handle and will hold the logs securely locked even if the structure is used as a movable drop box.

For fowl such as quail or pheasant, place a box with one corner projecting slightly over a low bank, or dig a trench or

ditch from well outside to just inside the box. A fowl enticed into the box by a baited trail laid in the trench will try to find an escape route at or above its normal eye level and will not normally find the hole beneath its feet. To make sure that it doesn't, heap some loose dry grass or leaves in the box and scatter bait through this. In looking for this bait, birds will scratch loose material into the escape hole, blocking their only way out.

Make a trigger to drop a box over an animal or bird by balancing the box so delicately on a propping stick that the slightest touch will upset it. Prop the box on a stick and wait in ambush to jerk the stick with a string or to nudge the box with a pole at the proper moment. You can also use a trigger such as the "figure four," the "toggle stick," or the "post and wedge." Each of these will work as well with a deadfall. (See Figure 10.)

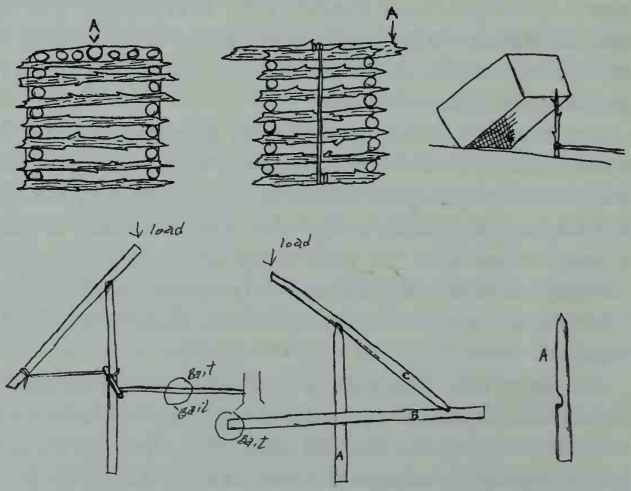

Figure 10: Box traps & triggers

Make a stake box by driving sharpened stakes to form a three-sided palisade pen. Roof it and make a drop gate at the open end or lay a roof of logs parallel to the long sides and hinged at the closed end so that it will fall to close off the open end. Use a stick and toggle trigger.

Make an open-ended stake pen with drop gates at both ends. As this resembles a tunnel rather than a closed box, animals will enter it more readily than a closed-end pen. Lay a solid roof of logs and pivot or hinge a door at each end. These doors must be somewhat wider than the openings. Drive two slanted stakes at each end, locating them two inches or so from the outer and lower edges of the closed doors and far enough apart to let the falling doors pass freely between them. Cut two jam logs considerably longer than the span between the stakes and two inches or so in diameter. These must be almost perfectly straight and you must trim them smoothly. Lay short logs three inches or so in diameter across the roof logs a foot or so in from each end to serve as pivots or fulcrums. Cut two long, stiff sticks to serve as levers. Tie one end of stick to the bottom of the door, raise the door and prop it in position, then lay the lever stick across its fulcrum. Cut a trigger stick an inch or more in diameter and long enough to reach from a foot above the roof to within a foot or less of the ground. Cut a deep notch in the center of this, with the square side of the notch at the bottom. Cut two notches on opposite sides of this stick, one about five and the other about seven inches above the lower notch, with one of them being oriented to match the lower one, and both of them having the square side at the top. With the doors propped in raised position, cut the lever sticks to length and carefully shape their ends to fit these last notches.

Remove the roof log that lies directly below the lever ends, cut a square-sided notch in one side of it that is deep

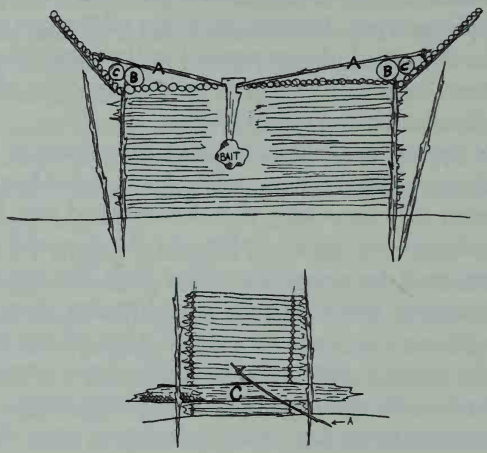

Figure 11: Double-end tunnel trap

enough to let the largest girth of the trigger stick lie loosely in it, then carefully square its bottom surface to match the square side of the deep notch on the trigger stick. Return the log to the roof and tie it firmly into position. Slide the trigger stick through its hole and engage the notch with the squared surface. Place bait of some kind on its lower end. Place the shaped end of each door's lever in the appropriate notch. Once this is done, lay a jam log in poisition on each door and remove the props that have held them open. When the bait stick is moved, its notch will slip off the squared log, and the weight of the doors will jerk it upward, releasing the levers. The doors will fall to close off the openings and the jam logs will roll down the doors to wedge themselves firmly between the doors and the slanting stakes. (See Figure 11.)

A deadfall is essentially a heavy weight so suspended or propped over a bait or a trail or runway that it will fall upon

and disable or kill anything attempting to get that bait or travel that trail or runway. Its effectiveness depends upon the amount of weight involved, the length of stroke, the type of backstop, and the nature of the striking object. Each of these can be modified to fit the circumstances.

Increase the weight by adding heavy objects to the deadfall after it is set or create a compounding effect by placing a second rock or log in such a position that it will increase both the speed and the weight of the stroke. Raise the deadfall higher, or add a *coup de grace* stroke by making a second and heavier deadfall to deliver a second and harder blow when it is triggered by the fall of the first.

A suitable backstop is a log or rock so placed that the target animal (if it is a fairly large one) must be standing with its front feet on one side and its back feet on the other when it trips the deadfall. If you cannot so arrange matters, drive stakes in the ground beneath the deadfall and sharpen their upper ends. For long-necked animals such as antelope, deer, or elk, make one stretch its neck across a waist-high pole or log to reach the bait or bump the trip lever.

Arm the striking log by sharpening branch stubs on its lower side or lash spears to it. Let the sharpened forks of a compounding log project below the striker. The object is to ensure the speedy death of the animal sought, so suit the method to the target.

With smaller animals, the deadfall can simply catch and hold the animal against the ground or between the deadfall and a backstop pole. It is better to have the deadfall deliver a killing blow even with such animals, but it is not absolutely necessary; and it is neither necessary nor advisable to leave sharpened projections to spear the animal. For such small animals, a figure four, post and cam, or a stick and toggle trigger work best.

The simplest of all deadfalls involving bait is one involving a weight suspended by a wire or cord that is interrupted

by a section that is either part of, or is held in place by, the bait itself. Lead the wire or cord upward from the high end of the deadfall and over a limb or other "pulley." Bring the free end back down nearly to ground level and pass it under some sort of hold-down, then lead the edible section across the area directly under the deadfall and secure it at a point opposite the hold-down. If cord or wire is limited, use a slender pole as a lever, tying it by a short length of cord to the deadfall, passing the lever over the limb, and bringing the end of the lever down almost to ground level. You can then tie the lever tip with bait, but the lever must have room to complete its arc without striking anything. For a porcupine, the bait can be a salt-impregnated cord or stick. Porcupines are always salt-starved and will eat anything containing salt. Use meat or a piece of fresh skin or intestine for meat-eating animals. The bait must in any case be something that will entice the target animal into eating it.

The Indians made a trap for otter and coon that is one of the easiest to make and the deadliest to use for beaver, coon, opossum, porcupine, or any animal of similar size. Drive a forked stake and a somewhat shorter unforked stake on each side of a well-used trail. Both the forks should be about three feet from the ground and so oriented that a support pole laid in the forks will span the trail. The gap between a forked stake and its unforked companion should not be more than two inches. Cut two sticks an inch or so in diameter and lay them between the paired stakes so they, too, span the trail. Tie a stout thong or cord to the middle of one of these sticks and to the end of the trigger stick thirty inches or so long. Bring this trigger stick up and over the supporting pole and bring its end down until it parallels the stakes. One of the cross sticks will then be suspended just slightly lower (six inches or so) than the support pole. Raise the second of the cross sticks until it holds the trigger stick in position. Lay the

ends of two heavy logs on the suspended cross stick (it will be necessary to brace one end up until the second log can balance the first) to provide the necessary killing power. If logs are not available, lash rocks to the ends of the killing bar. When an animal attempts to scamper over the lower cross stick, it will dislodge the trigger, and the upper stick will fall like a dull guillotine. (See Figure 12.)

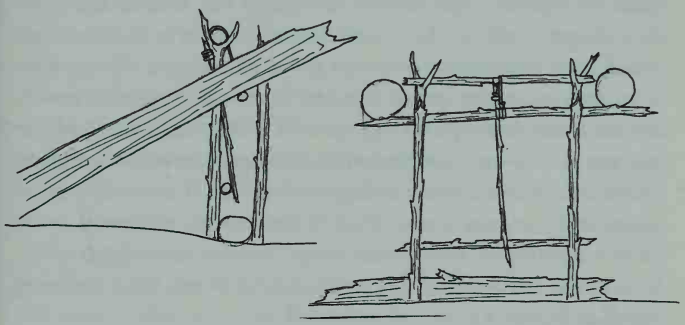

Figure 12: Indian otter trap

To make a large-animal deadfall built between two guide trees, raise a good-sized pole between two trees so that the smaller end lies on the ground and the heavier, raised end projects several feet beyond the guide trees. Tie it in raised position well above where your resting log is to be. Cut a pole two inches or so in diameter and long enough to reach from a supporting branch on the rear side of one tree to a point six inches beyond the second tree. This will be the resting log. Cut a second pole with an upward-pointing fork near its base and an inch and a half thick above the fork. Hang this fork over a branch two feet or more above the planned height of the resting log and mark it where the resting log is to be. Cut a similar stick and notch and bind the

two together so that the two crotches face each other, are rotated ninety degrees, and are the proper distance apart. Hang one fork over its branch and lay the resting log in the other. One end of the resting log should be resting solidly on a branch, and it should be level or nearly so.

Cut a trigger pole two inches or so in diameter, with an upward-pointing fork near its base. Hang this fork over the resting log just inside the suspending fork and bring the small end down and forward alongside the second tree. Tie this trigger pole to the trunk of the tree at a point somewhere near its middle to form a pivot or fulcrum. Secure bait of some kind to its lower end and fasten it so firmly that an animal must really jerk to get it free. Fence the bait so a bear can get at it from one direction only and must be standing under the deadfall when it tugs at the bait. If your target is a grass-eating animal rather than a meat eater, you must use a snare to entrap it and tie the snare wire to the trigger pole. Release the tied deadfall log and lower it to rest on the resting log. (See Figure 13.)

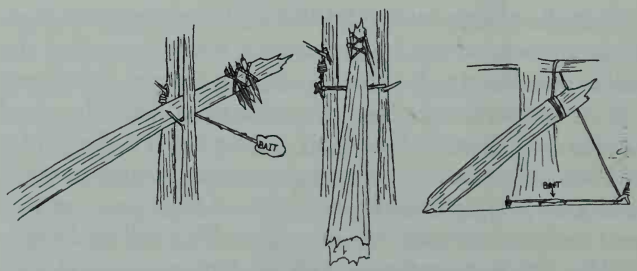

Figure 13: Deadfall

A hard pull on the trigger pole will either pull the resting log off its supporting branch or lever the fork of the hanging pole off its end, and the deadfall will come crashing down.

A smaller and more sensitive version of this can be made for smaller animals by using a trigger cam between the mating surfaces of a slightly different trigger mechanism.

A basic or blunder snare is a noose so placed in a runway or trail that an animal using it will run its head through the loop. An animal so caught will usually try to escape by lunging ahead, and this will draw the noose tight. The cord or wire can be secured to a stake, a convenient tree, or a bush. When the ground is covered with snow, use a drag stick.

Don't use this type of snare for large and powerful animals, as they are likely to break the strongest cord or wire you could have with you. Cord is unsuitable for carnivorous animals other than cats, as they will bite or chew their way through it.

To make a multiple blunder snare for rabbits or for quail or other fowl on one trail, lay a small evergreen tree across the trail. Cut out lower branches to make a series of openings and put a snare in each one. You will rarely catch more than one bird out of a covey, as the frightened struggle of one bird is apt to frighten the others away. A rabbit will quickly choke itself to death, however; and another rabbit will not be frightened by finding its way blocked by a dead rabbit in a snare. It will normally just move to another opening. Neither rabbits nor fowls will abandon use of a trail because one of their number has been caught there.

Make a similar set for tree squirrels by propping a pole at an angle against a tree that shows squirrel sign. Place a series of snares along the pole. Squirrels will often use the pole as a shortcut. The first to do so will run its head through a noose, struggle, and fall off the pole. Once it has ceased to struggle, its dangling dead body will not deter other squirrels from using the pole and being caught.

You can use a small pole covered with fine snares to catch perching or roosting birds. Place such a pole in a horizontal position in a bush or tree either frequented by or used as a roost by the birds you are after, or allow it to project well beyond all foliage to resemble a horizontal dead limb. Use a series of snares tied to a long wire or cord laid across a sand bar or on a log where waterfowl either roost or congregate, and trigger it by a good strong jerk on its free end.

Make a snare that will either lift an animal off the ground or place so much upward tension on the animal as to render it helpless. Use a bent-over sapling as a springpole or use a balance pole or a counterweight to provide the lifting force. Each of these has advantages and disadvantages when measured against the others.

A springpole is easy to make and needs little wire or cord beyond that used for the noose itself. You must find a sapling in the right location, however, and this is sometimes difficult. The sapling also tends to lose resiliency if left bent too long or in freezing weather; and you could not possibly bend a tree large enough to be really useful against large animals.

To test a sapling for use as a springpole, bend it into an inverted **U**-shape, then release it. Unless its return to an upright position is sudden, violent, and complete, it is not suitable for any but the lightest and weakest of animals. If you decide that it will serve, trim off all branches, as these would tend to slow or impede rebound and might also serve to warn wary or suspicious animals. Carry the branches some distance away.

A balance pole also requires little cord beyond that used for the noose. It is little affected by weather (deep snow will shorten its fall and its lift) and can be left set for extended periods without losing its effectiveness. You will have to find or build a pivot or fulcrum at the appropriate spot, however; will have to move the heavy pole to that location; and

will have to use sheer poles or a windlass to lift a large pole into position.

The balance pole is essentially a pole so pivoted that most of its weight is on one side of the fulcrum. The heavy end is high in the air so that its weight will provide leverage to jerk the victim off the ground when the set is sprung, and the small end is held down by the trigger mechanism. Trees or driven stakes must prevent the heavy end from being moved about by the frantic struggles of the victim after it has fallen, and it must be heavy enough to prevent that victim from getting decent purchase or traction on the ground if it is too heavy to be lifted bodily. It is possible to make springy "hold-downs" to keep the heavy end from being raised again.

A counterweight is useful in treeless country, is little affected by any weather but deep snow, and can be left set indefinitely. It consists of a heavy rock or other object so placed on a stump, log, boulder, or sidehill that only the tension of the snare keeps it from falling or rolling. It can also be a heavy object suspended in midair by the cord or wire. Its only disadvantage is that it requires much more cord or wire than either the springpole or the balance pole.

The cord or wire must pass through the fork of a tree, across a limb, a crossbar, a tripod, or a large log or boulder. The wire or cord must be so placed on these primitive pulleys that it cannot be pulled off the side, as this would create enough slack for the victim to regain full contact with the ground. Unless the snareward side of the log, rock, or other such object used is so overhanging that the animal could not possibly climb when against it, you must either provide a hold-down for the animal to be jerked against or for a hold-off to hold the snare wire away from its surface. Neither of these is necessary if the animal will be suspended out of reach of any solid surface. (See Figure 14.)

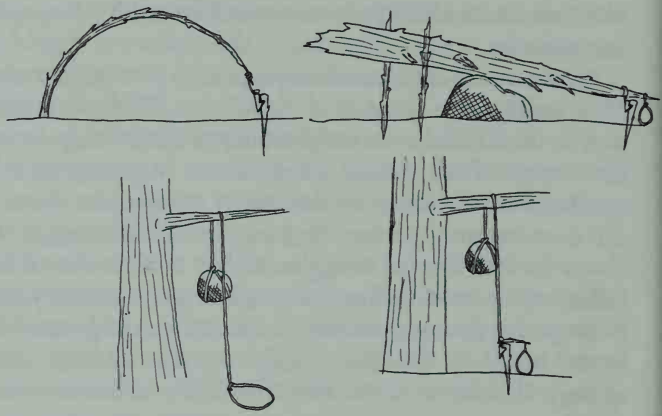

Figure 14: Springpole, balance pole, counterweight

One other version of the counterweight works with very little cord or wire and does not actually lift the animal at all, but is useful only on a steep slope or bank. In this set, a large rock or log chunk is chocked or braced in position just downhill from two saplings that grow close together or from two closely-set and deeply-embedded rocks. The cord or wire is fastened to the boulder or chunk and the free end is passed between the bases of the saplings or through the gaps between the rocks. The wire is fastened to a trigger mechanism and a noose is placed in position. The final action in setting the snare is to remove the chocks so the rock or chunk is free to roll down the hill, being restrained only by the snare wire. When the set is triggered, the snare will jerk the animal against the trees or rocks and will hold it helpless or strangle it. The steeper the hill, the more effective the set.

Triggers for unbaited hoisting snares are easily made. One of the simplest is the double notch. For a springpole, bend the sapling until the tip nearly touches the side of a rabbit trail. Cut off the top and whittle a groove to hold the wire

or cord. (If you cut it above a side branch or fork, no groove will be needed.) Cut a stick three or four inches long and an inch or more in diameter. Make a notch with its square side an inch or so from one end and make a groove around the other end. Cut a matching notch in a cut-off stub beside the trail or drive a prenotched stake, this time with the square side of the notch toward the top. Tie one end of the wire or cord to the springpole tip and tie the notched stick at two or three inches from that tip. Make a snare noose in the free end of the wire.

Bend the springpole over and hook the two notches together. Place the noose in the trail, holding it open by bending thin grass stems or pine needles around the wire or cord and sticking the ends in slits made in fencing branches placed around the noose. Trip the snare to make sure it doesn't hang up and to test the sensitivity. Adjust this by varying the angles and the depths of the trigger surfaces. This will work just as well with a balance pole or a counterweight. If the springpole tip is large enough, you can omit the notched stick and carve the notch in the springpole itself.

A variation of this that works splendidly with a balance pole is to drive a three-foot-tall forked stake beside a rabbit trail. Cut a second forked stake, cut one side of it to two or three inches long, and leave the other eighteen to twenty-four inches long. Sharpen this long side and drive the stake, this time crotch downward, on the opposite side of the trail. The smaller limb of this fork should be on the trail side. Lay a balance pole in the first fork and put its flattened tip under the downward-pointing side of the second fork. Attach a snare noose to the pole at a point near its tip, then hang a heavy rock or any other weight to the raised end.

Make another trigger by hooking a flattened branch stub on an angled trigger stick under the flattened end of a projecting branch stub on a trailside tree. Tie the wire or cord in a groove cut into this trigger stick, then lead one free end

of the wire out to the longer end of the stick and hang the noose there. The other end of the wire is then tied to the force provider.

Make a trigger by placing a flattened trigger stick under the flattened ends of two branch stubs near the base of a trailside tree. Tie the wire or cord in a groove cut into this stick, leaving enough of it free to make a noose on one end and to connect to the force provider on the other. Place the noose in the trail as before. A hard yank should free the trigger stick from the stubs. Govern the sensitivity by shaping the contact surfaces. The wire leading from the noose and the force provider should form a very shallow **V**, with the trigger at its apex. This will pull the trigger stick out, not up.

Make another trigger by cutting a straight stick an inch or so in diameter and eighteen inches or more long. Make a noose in the wire or cord and secure it to the small end of this trigger stick at a point not more than inch from the noose. Lead the wire down the length of the stick and tie it firmly about two inches from the large end. Set it by placing this stub end against one side of a driven stake or a trailside stub, and run the wire or cord around the other side of this and under the projecting stub end. When an animal is caught in the noose, the trigger stick becomes a lever transmitting the force of its struggle along its length, and the butt of this lever will quickly free itself of the wire or cord that restrains it. The upward pull of the cord or wire will hold the trigger stick securely in place until or unless it is dislodged by such force.

Another excellent trigger is made by driving a prenotched stake (growing saplings are always preferred if you can find them properly located) on each side of the trail. The notches must be square at their upper edge, and must be at least sixteen to eighteen inches above ground level. Cut a green stick an inch or more in diameter and long enough to reach between the stakes with room to spare, and having a side

branch running at near right angles somewhere near its middle. Cut this limb to sixteen inches or so. Then, holding the stick with the limb parallel to the ground, square the top and the side opposite to the limb where they are to fit the notches. Tie the cord or wire around the main stick at its junction with the limb, run one end out to the tip of the side branch and hang a noose there. Tie the other free end to the force provider. To set, place the stick in the stake notches. When an animal is captured, its movements will twist the stick out of the notches.

Make snares for baitable animals almost as easily, using the same systems to provided lifting force. Fence the bait to make sure an animal can get to it from one side only and place the bait and the snare so that the animal must be within the grasp of the noose to touch the bait. When you find fencing impractical or when wire or cord is plentiful, simply place additional nooses to cover all avenues of approach.

The most sensitive trigger for baited snares are the stick and toggle, the double fork, the notch and squared face, and the notch and chisel. Each of these has several variants and can be modified to fit the situation and the materials at hand.

The stick and toggle consists of a short stick with a wire leading to the force provider tied to one end. The other, much longer end is passed under a horizontal bar or around a vertical bar (a stake, the base of a sapling or bush) and a bait stick or trigger is braced against the very end of it to hold it in position.

The double fork trigger is even more sensitive and can be set to spring as easily as a mouse trap. Cut two forked stakes, leaving one side of each fork sixteen inches or more long but cutting the other side to two or three inches. Cut the main stem of one fork short but leave that of the other five or six inches long. Drive the long side of this second fork into the ground until the short side nearly touches the ground. If the

target is large or the ground is soft and loose, lash this fork to the base or stump of a sapling to prevent its being pulled up by the tension of the snare. Hook the fork of the second piece through the fork of the first in such fashion that its long side roughly parallels the upward-pointing main stem of the first. Mark and carve facing notches and whittle and shape a stick to fit between them. Make a groove around the at the center of this stick and tie the wire or cord there at a suitable distance from the noose.

To use, bend the springpole or lift the balance pole or counterweight into position and carefully fit the trigger stick into its notches. Bait the long side of the movable fork and place the noose around or under the bait so the animal must be within reach of the noose to reach the bait. Trip the device to test it. Govern the sensitivity by changing the angle and depth of the mating surfaces. (See Figure 15.)

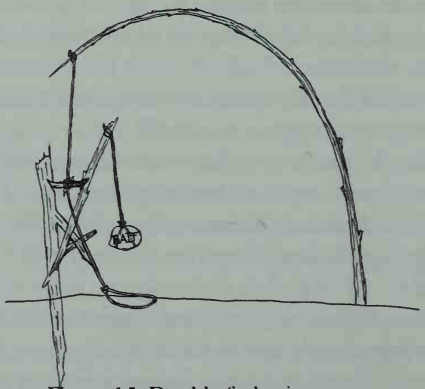

Figure 15: Double fork trigger

The notch and squared face is made by squaring off two adjacent sides of a horizontal bar placed two or more feet from the ground. A bait stick of equal length is then cut and

a groove is made around its larger end. Carve a deep notch within two or three inches of the wire groove, with the square side of the notch to fit the bottom of the squared crossbar and the belly to fit its squared side. The bait is fixed to the long end of the bait stick, which is near the ground. Sensitivity is governed by the relative lengths of the two sections above and below the crossbar and by the depth of the notch.

The notch and chisel involves a bait stick exactly like that just used and described. In this trigger, you must drive a forked stake so the fork is aimed downward and the tip of its short side branch left eighteen inches or more from the ground. Shape this point to a chisel edge and hook the notch on this.

You can make each and every one of these triggers in any size and in any plane, and a trigger stick can be tripped or activated by a wire or cord. This allows you to make club, flail, spear, or catapult traps suitable for large animals.

It can never be too strongly emphasized that these larger traps are potential man killers. *NEVER SET SUCH TRAPS ALONG A TRAIL OR PATH WITHOUT PLACING ADEQUATE WARNING SIGNS WHERE ANYONE USING THAT TRAIL CANNOT FAIL TO SEE THEM!* Remember always that no matter how isolated you may consider yourself to be, other persons may come there at any time, perhaps even looking for you. You do not want to greet a rescue party by killing or maiming one of its members!

Use a large balance pole as a club by using a fulcrum or pivot at one side of a trail. There should be trees or other barriers on the other side so the animal cannot sidestep the blow. You can substitute a version of the suspended booby trap or spear-armed hanging platform used by the Viet Cong for the balance pole if you have rope heavy enough to suspend it. Use any one of the triggers for baited snares, running

a trip wire across the trail instead of using bait. An alternate method is to use a very large version of the double fork trigger.

Make a club or flail trap that operates in a horizontal plane. Lash the tips of several limber poles (it is easier to bend several, one at a time, than to bend a large one) between trees on one side of a game trail in such fashion that the butts rest with considerable tension against a backstop on the far side of the trail. This can be a log end, a stump, a large rock, or a good-sized tree. Leave several branch stubs a foot or so long on the backstop side of these butts and sharpen them as spears. Spears can also be lashed to the butts. Bend the poles one at a time and tie them securely to a standing tree (remember that you are in front of some bent ones until all are back!), then lash them into a bundle. Run a trip wire across the trail and fasten it to one of the triggers already described. An alternate trigger, in case you have no wire, is a double fork made entirely of small poles. Once the trigger mechanism is in place, release the ties that hold the poles in bent position, letting the trigger hold them. This trap is highly effective against large animals.

Make a small spear trap by lashing a springy pole vertically to the side of a tree and bending the lower or spear-bearing end away from the trunk. When sprung, the trap will catch the animal between spear pole and tree.

Make a flail set to catch small birds and animals. Weave sticks to form a fly-swatter–type flail, put the end of its "handle" under a log or rock, and bend the swatter end away from the ground. Use any of the described triggers to hold it in position. When sprung, it will hit the victim a considerable blow and will hold it between flail and ground. This is highly effective, especially against small rodents.

You can easily make a set bow, using a stick and toggle for a trigger and running a trip wire to it. This is a deadly trap that was used by wartime survivors downed in enemy

territory. Use this device only over bait or to take a bear as it emerges from its den, perhaps forced to do so by fire or smoke. *Do not use it on a trail, unless you are prepared to face a charge of manslaughter!*

Catch birds by digging a pit (the hole left by an uprooted tree will often do) or by heaping walls of snow or logs to form a pitlike enclosure. Either one must be a foot or more deep and the sides must be vertical. Lay slender poles or wands across the pit to form a slatted grating, lashing or bracing the ends to hold them in place. Space them four inches apart for jay- or magpie-sized birds, somewhat wider for birds such as ducks, ravens, or crows. Bait liberally. Birds will enter the pit by hopping down through the grating, but they cannot get out without flying; their spread wings are too wide to pass through the grating.

Catch ducks and geese or other large birds by digging a deep and narrow trench with one sloping end. When birds have followed a baited trail into the trench, rush at them from the entry end to startle them into attempted flight. Unable to spread their wings, they are helpless before someone with a club. A narrow, three-sided pen made of sticks will serve as well.

Catch "glutton birds" such as camprobbers, crows, gulls, jays, and magpies by placing fishhooks in bait and attaching these by a short line to a weight too heavy for the bird to lift. If you have no hooks, make gorge hooks of wood or bone, sharpening an inch-long splinter at both ends and securing the line to a groove in the middle. Turn this parallel to the line and insert it in the bait. When a bird swallows the bait, the pull of the line will turn the gorge crosswise. This works very well for grain-eating birds, too, but you will have to use a nut or a very large seed softened by boiling.

An alternative way of catching such birds is to thread one end of a cord such as fishline through a piece of bait, then bring the end back to tie around the standing cord, forming a slip noose with the bait on one side. Tie the cord to a suitable weight. When a bird picks up and attempts to swallow the bait, the noose will encircle one half of the beak, and its struggle will keep the noose tight.

For birds such as ducks, geese, and swans, place a baited hook on a rock protruding from shallow water (not less than eighteen inches or more than three feet deep) or on a floating chunk of log anchored there. Tie the hook to a line not more than a foot long and tie this to rock weighing two or more pounds. When the bird picks up the bait, it will jerk the weight into the water, and the weight will hold its head under water until it drowns. This will work for gulls or crows, too; and a live minnow or frog tethered to the weight and allowed to swim around will catch fish-eating birds. If the water is deep, attach a float to a longer line and tie this to the weight, as this will let you locate a bird that is completely submerged.

It cannot be too strongly emphasized that these methods are for emergency use only and are both repugnant to most people and unlawful. Some of the deadfalls, snares, and traps described here were and are now being used by trappers engaged in lawful trapping for fur-bearing animals, but no state or province allows their use for any large or small game animal or bird.

With your life at stake, of course, you would ignore such considerations, and most agencies would overlook violations made under such circumstances. In any case, you could not be punished for the violation until you have been found or restored to civilization; it would be far better to subject yourself to a fine than to starve!

You should also know more about traps than simply how to set them.

Chapter XVI

Trapping Know-How

The key to successful deadfalls, snares, or traps is proper placement. It obviously does no good to set a trap for an animal that does not frequent the area. Knowing where to set the trap is therefore fully as important as knowing how to make it. Only a study of the creature's habits, either through direct observation or by careful examination of the signs it leaves, will enable you to take advantage of those habits.

Not only birds of prey (hawks, owls, eagles, etc.) but carrion eaters and smaller birds like to perch on a dead snag or stub. A pole thrust up from a patch of low brush or from the middle of a glade or meadow will provide such a perch, and snares set at the tip and on any projecting branch stubs near the top will catch such birds fairly reliably.

Rabbits or hares tend to use regular patterns of movement, and they create regularly used trails. These trails are easily seen in snow and can usually be located when there is no snow. If no trails are seen but rabbit droppings are in evidence, use a stiffly branched dead limb as a crude harrow to stir up the soil in a grid pattern to so their trails will show. Place your snare or trap at the point of greatest traffic.

Numerous species (ground squirrels, true rabbits, marmots, woodchucks, etc.) live in dens or burrows, and the entrance to such dens are perfect sites for traps. The temporary dens of badgers, coyotes, and even bears are also good locations.

Many animals reside in hollow trees, usually hardwood species; and many of these trees lean slightly or strongly off the vertical. An examination of the high side of such trees will show clawmarks and discoloration if the tree is regularly used. Lean a log against this high side and place a snare on it in such a position that any animal going up or down the tree will be caught. With straight trunks, use several poles.

Other animals such as packrats, woodrats, tree squirrels, muskrats, and beaver build conspicuous nests, and the entrances to most such nests are ideal trap sites. Tree squirrels usually build their nests so high off the ground that it entails a dangerous climb to reach them. For beaver, you may have to knock away part of the dam to lower the water low enough to reach the entry. If that is not practical, tear a small hole in the dam and set traps or snares to catch the beaver as it comes to make repairs. Some of these will catch only chunks of wood, so set several.

Beavers often dig canals in order to transport logs or limbs for construction or food, and such canals offer splendid locations for traps. You must first make sure to drive all beavers from the cutting area back to their pond, so the trap will take only an animal going to the work area. If you neglect this, your snare may catch only a log or limb, leaving a dazed and toothless beaver to wonder where his log has gone!

Most big game and many smaller animals follow regular trails, and well-used trails are readily recognized. Most such game litters the trail with its droppings, and an examination of this gives a fair idea of when and how often the trail is used. Following such trails for a short distance will often lead you to an intersection with a larger trail, and you can set a trap or snare on both branches.

In desert country, a waterhole is an ideal place to set snares and traps, but you can rarely find the necessary materials there. Simply set blunder snares secured to heavy drags

and rely on the animals' escape attempts to tighten nooses. Such country often has lava rims that extend for miles, with only infrequent breaks or gaps. All animals that wish to go up or down such walls (except those that can climb) must do so through these gaps, and such sites are also good locations for traps.

Remember always that you must first study the situation to determine what an animal does, and then arrange your deadfall, snare, or trap to catch him in the act. Baits and lures are also highly effective when suited to the animal sought.

Salt will entice antelope, deer, elk, goat, moose, porcupine, rabbit, and sheep. Fish, meat, or blood will attract all types of flesh eaters, ranging from shrews to badgers, bears, bobcats, coons, cougars, coyotes, foxes, lynxes, possums, and wolves. These will also attract both predatory and carrion-eating birds, including buzzards, crows, eagles, gulls, jays, magpies, and ravens.

Crumbs, grass or weed seeds, and smaller nut kernels will attract most birds and fowl such as quail or pheasant. These and larger nuts such as acorns will attract ducks, geese, and turkeys as well as mice, rats, and squirrels. Insects, grubs, and worms will attract many of the smaller birds and some of the smaller animals. Fish, frogs, and salamanders (these killed and skinned) are excellent bait for many of the wading birds and for some of the flesh eaters. A tethered bird, lizard, or snake will lure hawks, owls, and eagles.

Honey is outstanding bait for bears, coons, martens, and skunks; but you would have to find a bee tree to get it. A consideration here is that no natural food exceeds honey in nutritional value, and you might better simply eat it than use it as bait. Another consideration, of course, is that robbing a bee tree is not without hazard! If you find a bee tree and decide to rob it (assuming that the honey is accessible), burn spongy, punky wood in an almost airtight container to

produce dense smoke. You can make such a container of baked clay if you have nothing else suitable. Set this smoking container within the hive itself to stupefy the bees, or rig a homemade bellows to puff smoke into the hive.

Most lures used by trappers are scents made from the glands or urine of the animals sought. Many and exotic were the ingredients and methods of culture used by old-time trappers, and most such recipes went to the grave with their creators. To those who have been privileged to smell some of these concoctions, the permanent loss of the formulae is not a matter of regret! One old trapper I knew made a coyote lure comprised in part of fish heads, coyote urine, and anise oil mixed with other ingredients unknown to me in a bottle and set aside in warm place to "ripen." After several months, it was either adjudged "jest right" or "spiled," with the former to be saved for use and the latter to be buried in unopened condition. To my unsophisticated nose, they were both spoiled beyond redemption; and I think even the coyotes approached with extreme caution and from upwind, possibly with paws held over their noses! They did approach, however, as he always caught a good many.

Under survival conditions you will have neither the time nor the inclination to make such lures, but fresh lures will work. If you catch and kill a coyote, for example, save the bladder full of urine to sprinkle on bushes at trap or snare sites. This is especially effective if the animal providing the urine is an adult female; but male urine sprinkled on a rock, stump, or bush will cause any passing coyote to stop to inspect this "sign post." Beaver castor, the musky exudeate from a beaver's anal glands, will attract most carnivores as well as other beavers.

Other lures can be bright and shiny objects such as a ring, a piece of mirror, or perhaps a polished dime or quarter. Animals such as packrats and coons, and birds such as jays,

magpies, and crows are possessed of an insatiable curiosity and a strong acquisitive instinct; they will try to carry such objects away.

Porcupines, hares and rabbits, skunks, ground squirrels, woodrats, etc. are notoriously stupid and unsuspicious, and disturbances of the environment or the lingering scent of man will not normally deter them from approaching a baited set or blundering into a trail set. This applies to most birds as well. Most other animals are much more sensitive to such disturbances or odors, and you must be as careful as you can be when setting traps for them.

Be careful not to be caught in or injured by a trap of your own devising! Remember always to work from behind the sweep of a flail, outside the grasp of a snare, and out of the path of a falling deadfall. A snare noose will catch a human arm, head, or leg as readily as an animal, and a deadfall or flail will be no more gentle with you than it would be with your intended victim. The old movie shot of the bumbling tenderfoot dangling head down from a springpole is always good for a belly laugh, but there is nothing laughable about the real thing, especially when there is no one to help you get free.

A long toggle stick as used in the Indian otter trap described in Chapter 15 describes a wide arc when released, and this motion is both sudden and violent. Many old-time trappers, in fact, call these devices "fly poles." Be careful, then to allow for this motion when you trip a trap to test it, and be alert to the possibility of being struck by such trigger parts.

Remember always that under survival conditions you cannot afford even trivial injuries. As the body's energy reserves dwindle, its ability to resist infection, blood loss, or shock, as well as its ability to regenerate or repair lost or damaged tissue, is sharply reduced. Injuries so minor that they would

normally be ignored or treated with a dab of merthiolate can actually be life threatening under survival conditions. *Be extremely careful to avoid injury!*

Many of the books that deal with camping or with woodcraft show forked stakes in the form of a letter **Y**, and would have you believe that these stakes can be driven. Don't believe it! It is impossible to drive such stakes without splitting the crotch. Instead, you must choose stakes in which the main stem is straight or nearly so, with the side branch coming off at a narrow angle. Such a stake can be easily driven, as the force of the blows will be in direct line with the point. Even so, the tip of the main stem receiving the blows will itself split unless it is beveled at the edges or "sniped."

When setting traps in winter, remember the snow! It does no good at all to set a deadfall, snare, or trap where it will be buried or made inoperative by falling or blowing snow. Protect the trap by a bough or bark shelter, by building it on poles well above the probable snow level, or by setting it under a densely-canopied tree.

Remember, too, that even the bloody snow or ground where you have killed or dressed out an animal can serve as bait. Use any unwanted portions of your kills as additional bait. Any carniverous animal will investigate the smell of blood.

Be aware that most animals are very powerful for their size, and that desperation tends to multiply strength. When choosing counterweights or when adding weight to a balance pole or deadfall, then, it is wise to follow the advise of a trapper friend of mine who used to trap bear, which was a lawful activity then. He always said to "make your deadfall heavy enough to hold or kill any bear, then add at least twice that much more!"

Animals, birds, or other living creatures can also be taken by more direct means.

Chapter XVII

Improvisations

You can sometimes approach a roosting owl closely enough to be able to knock it down with a thrown stick or rock. You can often secure grouse or other "fool hens" in the same way, and they will sometimes allow you to get close enough to hit them with a hand-held stick.

Capture these birds, or lizards, snakes, turtles, or crayfish, with a wire noose fastened to the end of a long stick or wand. Use the stick to extend the noose, slip it over the head (or the claw of a crayfish), and jerk it tight. A noose formed in the end of a long grass stem works admirably for small lizards. If the movement is very slow, the target creature will rarely take alarm.

You can often kill a porcupine with a club, but this may entail some dangerous climbing. In winter a porcupine will climb an evergreen tree and stay there, living off the bark of the topmost trunk and branches. As this deforms and ruins the tree, these animals are poisoned and shot on sight by foresters. You can recognize a home tree in winter by its threadbare look, by the litter of droppings, needles, and bark fragments beneath the tree, and by snow that is stained or discolored by urine.

In summer these animals feed on tender herbs and forbs, generally at night, and spend their days resting in a tree. They are normally solitary, but communal groups sometimes share a resting tree, and I have seen as many as eight in one small juniper. The ground under such a tree will be cov-

ered several inches deep with their droppings. In treeless country, they will often live in a cluster of large boulders.

You will often see them waddling to and from their feeding grounds in late evening or early morning. They are not very fast, and you can easily overtake one on the ground. They are notoriously hard to kill, however, and you might have quite a struggle before you have one certifiably dead.

Once this is accomplished, you should have no difficulty skinning the animal, despite the fearsome quills. Start at the center of the belly (which has no quills) and fold the skin back over itself as you go. These animals are unbelievably rich in fat, both the entire carcass and all of the "innards" being encased in a layer of fat often as much as two inches thick. This fat and the ease of taking make the "porky" an excellent source of survival food. The meat ranges from very good to pretty bad in taste, this apparently largely dependent upon its choice of food.

A club is also useful against mice in their runways or any small animal or bird you can bring within its reach. For really small animals, a woven "swatter" is even more effective, as it requires less precision in aim and is less destructive of tissue. Geese and ducks are flightless when molting, and this makes them especially vulnerable to a club. Some seals are helpless on land, but adult animals are so large that a spiked club or a spear must be used to take them. They are not too dangerous to tackle with a club, just too hard to kill.

A throwing stick is very effective when used at short range against densely congregated birds, and you can quickly become so proficient with practice that you can use it against single animals or birds. Select a straight stick eighteen to twenty-four inches long and two inches or so in diameter. Throw it in such a manner that it will spin horizontally as it travels. You can refine this by choosing an angled piece and carving it to make a crude boomerang, but

most of us cannot use this any more effectively than the unshaped stick.

Use the surgical tubing from your emergency kit, a **Y**-shaped forked stick, and a piece of leather (from a shoe tongue, perhaps) to make a slingshot. Use marble-sized pebbles as projectiles. A minimum amount of practice will enable you to make occasional hits, and skill will quickly return if you used one in your youth. This is deadly against small birds and animals.

For an even deadlier weapon, whittle out a rifle stock and barrel with the top of the barrel grooved to receive an arrow. Use the surgical tubing and a leather thong to propel the arrow.

The sling that David is reported to have used so effectively against Goliath consists of two long leather thongs secured to opposite sides of a leather pouch. Such a device is easily made and is just as deadly today as it was reported to be then. One thong should be tied into a nonslip noose of a size to fit snugly over the middle finger of the throwing hand, and the other should have a large thumbknot tied in its free end.

To use, put an egg-sized rock in the pouch and stand with your feet somewhat apart and the left shoulder (if right-handed) pointed at the target. The knotted string should be held between the thumb and forefinger of the throwing hand, and the loaded sling should be dangling to barely clear the ground beside your right foot. Still keeping the arm fully extended, whip the sling up and around the body (only once) and release your grip on the knot when the sling has returned to the starting position. The rock will be lobbed to an incredible distance and at considerable speed, and the impact is capable of killing or disabling almost any animal.

For shots at closer range, the sling must be whirled in a more horizontal plane, but the technique is otherwise the

same. Do not whirl the sling more than once in an attempt to build velocity, as this is determined by the length of the strings used, and it is nearly impossible to achieve even moderate accuracy when more than one whirl is made.

It will require considerable practice to achieve a high degree of accuracy, but the sling is deadly when used against a dense congregation of birds or animals, where a miss is unlikely. *If part of a group, do not practice your first throws until all other members of the group are behind solid objects such as trees!* Your first few throws are apt to be uncontrolled, and anyone near you is apt to be at considerable risk! As the center of the circle the sling describes, you will be in no danger yourself.

A variant of the sling is a single string tied to a rock. Tie a thumbknot in the free end of the string and grip this between thumb and finger as before. The string is thrown with the rock.

Bolas consist of two or three weighted strings radiating from a common center. Cast it at a bird or animal in such fashion as to make it spin horizontally as it flies. The strings will wrap themselves tightly around any object struck and will secure themselves against unwinding. An even simpler version is a three-foot string with weighted ends. Grasp one weight and whirl the other around, then throw it at your target. It, too, will wrap around anything it strikes.

The bow and arrow is a highly effective weapon in the hands of someone skilled in its use, but is little more than a toy when a crude version is used by a novice. Even so, a bow that is fairly effective against fish or frogs can be made and used by almost anyone; and you might be able to make one suitable for use against animals and birds. The bow itself is not particularly hard to make, but good arrows are hard to come by.

If you want to use a bow against birds or animals but are unskilled in archery, make a crossbow. The bow is then held

in a stock and is pointed and shot like a rifle. The arrows or quarrels are then very short, only ten to fourteen inches long, and are easy to make. The only problem with a crossbow is to make a trigger sensitive enough to be released without jerking (this would deflect the aim), yet positive enough to hold the bow at full draw until you trigger it.

The most practical trigger you can make under primitive conditions involves a notch and lock-stick catch with a thumb latch release. Groove the top of the "barrel" to make a guide slot for the arrow. Cut a deep transverse notch where the gun action would be. This must be not less than three quarters of an inch deep, and it must be cut with a square shoulder at the front end, a flat bottom an inch long, and a concave ramp at the back end.

Cut a lock-stick an inch or so thick and an inch and a half longer than the bow is wide at the notch. Square the stick on two adjoining sides and whittle a string groove around each end. Tie short cords in these grooves and tie their free ends to the bowstring. The end result should look like a child's swing. The distance between the cords must be sufficient to let them move freely along the sides of the barrel.

To use, pull the bowstring to full draw position and drop the lock-stick into its notch. It should be positioned with one squared face against the forward end of the notch and with the other on the bottom of the lock-stick but at least one quarter inch above the floor of the notch.

Cut a thumb latch stick at least six inches long and half an inch thick, and shape the large end to fit snugly between the lock-stick and notch bottom. The forward quarter of the latch should be free of contact with the concave portion of the ramp, and the latch should rest on the angled corner where notch and stock meet. This point will serve as a pivot or fulcrum. The other three quarters should extend back more or less parallel to the top of the stock. The maximum

spread between stock and latch should not be more than two inches, and somewhat less is better. Press downward on the latch to pry the lock-stick up and out of the notch. Sensitivity is governed by the relative distances fore and aft of the pivot point, not by the strength of the bow.

Place the quarrel or bolt (arrow) in the barrel slot with the bowstring resting in a shallow groove cut in its base. Hold it in position by running at least two pine needles or thin grass stems across it and securing their ends in splits cut into the side of the barrel. This will allow you to hold the crossbow in almost any position without the arrow falling off.

Drive burrowing animals or tree dwellers from their dens or hollows with smoke. With den users, you will have to use a thin cover of some kind to force the smoke into the den rather than into the open air. You must also be at pains to locate each of the two or more entrances such dens often have and to set traps at or block these extra escape doors securely.

Flood animals out of their dens if they are near enough to a source of water. Drive packrats from their nests or log dwellers from their lairs by firing the nest or log if there is no chance of the fire spreading. Use a long, slender, barbed wand to spear an animal in its den or hollow if the curves in den or hollow are not too radical or acute. Leave a short fork at the tip of such a wand and thrust it into a shallow den to twist the fork into an animal's hide tightly enough to drag the animal within reach of a club.

You will quickly think of other on-the-spot methods of securing small creatures you have spotted. If necessity is the mother of invention, then hunger is the parent of ingenuity!

You may be able to drive a predator from its prey while it is still intact enough, and fresh enough, to be useful as food. Before appropriating this for your own use, ask yourself if you might better use all or part of it as bait for a trap

to catch the returning predator, thus gaining a larger supply of fresher meat.

No North American predator is likely to try to defend its prey against a human, with the notable exception of badgers, bears, and wolverines. With a badger, you can quickly make a spear or club that will settle any argument in your favor. With a bear or wolverine, discretion is always wiser than valor!

If you feel that you simply must have the meat on which a bear is feeding, but have no gun or other weapon with which to kill the bear, you must carefully plan and carry out an attack that uses the only available weapon: fire. It is said that even a grizzly will retreat, however reluctantly, when faced with a freely blazing torch. A large fire built near the purloined meat will keep the animal away long enough for you to build a snare, set-bow, or deadfall, or to cut a goodly supply of meat if this is still edible. Most such meat will be so "ripe" or so befouled that you would not dare eat it.

If you take some meat, you should then carry a freely blazing torch of some kind while moving well out of the area. When you think you are far enough from the scene of your theft, stop and make camp. Build a good-sized fire and gather enough wood to keep it going all night.

I would hesitate to try this myself, at least with a grizzly. I have no experience with grizzlies, but both their intelligence and their ferocity is legendary. All that I have read indicates that it would work, but bears don't read!

Never take chances with a bear, especially not where meat is concerned! A dozen bears might flee, even from a fresh kill, for every one that will try to defend its property; but the first one you encounter may be the one that chooses to defend! The black bear is usually timid where man is concerned, but this is by no means a universal trait. A brown bear (from Alaska), a grizzly, or a polar bear is much more

likely to fight for its meat. Polar bears, in fact, are reported to stalk men as they would prey, apparently mistaking them for seals! A bear is a creature of uncertain mood and temper, and you must take no unnecessary chances when dealing with one.

If you have a gun or other means of killing a bear, then by all means do so. Bears are heavily encased in fat in all but the early spring months, and this is one of the finest of all edible fats. It is also useful for waterproofing leather boots and shoes, for grooming the hair, as a medical salve, and for fuel. The hide of a bear is also extremely useful, either as a coat or a blanket.

Bears do not actually hibernate, they only sleep, and it is not too unusual to find them up and doing in midwinter when food is available. When one does sleep, its den is often revealed by a hole melted in the snow cover by its breath. You can use fire, smoke, or simple noise to drive a bear from its winter quarters, but do not do so without rigging a deadfall, a set-bow, or other deadly trap to kill it as it emerges. Bears are often "as grouchy as a bear" when aroused from a winter's nap, and a bear's ill-temper is not to be taken lightly!

Never eat bear meat without cooking it thoroughly at high temperatures! The bears, like the common hog (and humans), are omnivores; and they can transmit the dreaded *Trichina* worms to humans who eat infested meat that is rare or undercooked. Bears are unlikely to be infested with trichinosis unless they have had access to garbage containing uncooked pork scraps, but you should be aware of the potential hazard anyway. Trichinosis is reported to be one of the most painful afflictions known to man and has no cure; so take no chances. *Overdone is properly done with bear meat!*

A wolverine is said to be so incredibly vicious and vindictive that the wisest course would seem to be to leave him and

his meat alone. Any meat he has been feeding on would be so befouled as to be unusable in any case. If you have a gun, of course, you might kill and try to eat him—that is if your stomach is strong enough to let you even skin him. They are often known as "skunk bears" and are said to be able to give a skunk the first stink in any contest! I have no experience with them and have never even seen one, but I would personally avoid one as I would the plague unless actually starving.

If you harvest more meat than you can quickly use, as with an elk, a moose, a bear, or even an adult deer, you can preserve the meat in several ways. You can freeze it if the weather is cold enough; you can make it into jerky; or you can smoke it. If you choose to make jerky, you can then use some of this to make that famous survival food, pemmican.

To dry or smoke meat, use the rack described in Chapter XVIII. Cut the meat into strips not more than two inches wide nor more than half an inch thick. Skewer these on rods (of nontoxic woods only!), and lay them across the rack. For future use as pemmican, cut the strips across the grain of the meat. To make pemmican, pound the jerky into a meal and mix this with an equal volume of rendered fat. Stuff into casings made from the intestines, and smoke these to shrink and cure them.

All stored food, and especially strong-smelling foods such as meats, should be stored some distance from camp to prevent attracting marauding bears into camp. Hang the food at least ten feet off the ground and well away from a climbable tree. Wrap it in a tight covering to protect it from magpies and ravens, which also eat meat.

Another source of survival food is fish.

Chapter XVIII

Food from Fish

Fish provide food that is very rich in protein, but fresh fish are too low in caloric content to carry you for very long when eaten alone. You would have to eat almost twenty pounds of fresh trout a day to provide energy for vigorous activity! Fresh-caught salmon just out of the ocean, catfish, most ocean fish, and shellfish have about twice as many calories per unit volume as trout.

It is obvious, then, that the calories must be concentrated by smoking or drying the fish, or that the fish must be supplemented with calories from other sources.

You can catch fish with a hook and line (a whittled gorge hook and a homemade line will work), but this is apt to be a slow and uncertain process, as any angler can attest. A set-line with numerous hooks is a great deal better and does not need your constant attention. Better still, make a spear or gig, a clamp, a harpoon (for large fish), a stake trap, or a tide-pool trap. For crabs or crayfish, make a drop-side trap.

To make a spear, cut a long and slender pole or wand and sharpen the larger end. Whittle a backward-pointing barb or use a conveniently located branch stub as a barb. Harden the point by roasting it in a fire. Make a gig by lashing three or more barbed points to a pole.

A clamp was widely used by Indians. Make one by splitting a springy pole for a distance of a foot or more, using tightly wrapped wire or cord to keep it from splitting too far. Wedge the split open and carve cross grooves on the

inner surfaces to leave sharp-edged ridges. Then pry the tips apart and brace them open with the smallest and thinnest stick that will hold them. When this brace is driven against the body of a fish, it will become dislodged; and the clamp will spring closed to grip the fish.

Make a harpoon tip from a piece of deer antler, a bone, or a piece of fire-hardened wood. Whittle a long, peglike base that will fit into a socket at the tip of the harpoon pole, and make a groove or hole for the attachment of a cord. Tie the cord to the point and the pole, leaving enough slack to allow several feet of free play when the tip is pulled off the pole. Wrap several turns of this cord on the pole and pull a loop of slack up under this binding to hold the point in place.

Use woven dip nets to scoop up fish from small creeks and rivers. If the fish tend to dodge the net, you can often blind them by throwing quantities of dirt into the water or by stirring up bottom mud. Even a racquetlike scoop woven out of stiff sticks can be used to bat fish ashore.

Make a drop-side net for crabs and crayfish by making a circular, triangular, or square ring of tied-together limbs or sticks. You can use a woven basketwork of rigid sticks for a bottom. Make a second ring the same size and shape as the first. Tie weight rocks to this at intervals. Join the two rings with sides made of cloth or other flexible material. Tie several cords to the top ring to make a bridle attached to your pull-up rope. Tie some bait such as meat or fish in the center of the bottom and lay a fairly heavy rock beside it.

When you sink this contraption, the weighted sides will settle down around the weighted and baited center of the trap. When crabs or crayfish have crawled aboard to reach the bait, pull the trap up. The sides will be pulled up first to form barriers to escape.

A double-funnel trap woven of sticks will catch both fish and crayfish. The advantage of this is that it can be left unat-

tended for long periods while you do something else. (See Figure 16.)

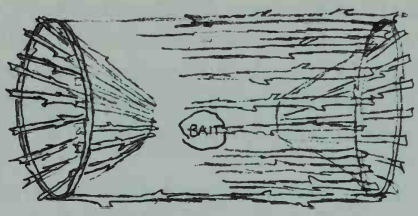

Figure 16: Double funnel fishtrap

No fish found in North America is poisonous (many tropical fish are), but a fish starts to spoil immediately after death in any but freezing temperatures, and spoiled fish is toxic. Prepare and eat fish as soon as caught. To prevent spoilage of any surplus, the best method is to keep the fish alive until needed, using a stake pen, a submerged woven basket, or a fenced-off inlet or dug pond to hold them. Catfish and bullheads will survive for days on a stringer.

The next best method is to freeze the fish if the weather is cold enough to let you do so. If the weather is not cold enough, then you must preserve the fish by drying or smoking if you can't keep them alive.

Dry or smoke small fish by cleaning them and then splitting them from the tail to the head, leaving the head to hold the two halves together. Hang by straddling the split halves over the drying-rack poles. Cut larger fish into strips not more than half an inch thick and skewer these on sharpened, nontoxic sticks, then lay these on the drying rack.

The drying rack should be made of four forked stakes (a tripod will serve as a stake) driven to form a square or rectangle. Lay a crosspole through the two forks on each side

and lay a number of slender drying poles across these. This grating should be not less than three feet in height, and five or six feet is better.

Build a fire of alder, aspen, birch, cottonwood, or willow beneath the rack, keeping it low enough that it will not cook the fish and smoky enough to keep flies away. Keep the fire going until a piece of fish will break with a snap and until the center of a broken piece is hard and dry. The fish is dried, rather than smoked.

When smoking fish, dig a trench from the drying rack to a point some distance away on the downhill side. Dig a fire pit there and cover it with a large flat rock to confine the fire. Roof the trench with cut sods or with rocks and dirt to make a smoke pipe. Keep the fire supplied with green, nonresinous, and nontoxic wood to make a dense smoke. Shroud the rack with stacked boughs or slabs of bark to contain and confine the smoke.

The mussels found in great abundance along the Pacific coast are edible, but these and other Pacific shellfish are poisonous at times. You will have heard that they are dangerous in any month without an *R*, but this is simply not true. No one can forecast with any accuracy when, or to what degree, shellfish will be rendered toxic by marine organisms they feed on. These toxins are fortunately as harmful to animals and birds as to man, and an unusual number of dead animals or birds along the shore usually serves as adequate warning. With this one notable exception, shellfish are edible, although freshwater shellfish should be thoroughly cooked to destroy any parasites or bacteria they might harbor.

Periwinkles, helgramites, and most other nymphs of water-hatching insects are edible. So are sea cucumbers, eels, tadpoles, and adult frogs, and turtles. Streams, marshes, and other permanently wet areas also produce numerous edible plants.

Chapter XIX

Food from Plants

Never eat any plant unless you are certain beyond doubt that it is edible! Nonedible plants and their fruits range from mildly irritating to deadly poisonous, and your first mistake may well be your last! Plants of similar appearance may be radically different in chemical makeup, so don't eat a plant just because it looks somewhat like another plant you know to be edible. *If in doubt of identity, do not use!*

There is no such thing as a safe test for edibility! You have probably read that you can test for edibility by holding some part of a plant in the mouth or by chewing it thoroughly without swallowing. If no burning, numbing, or stinging sensation results, you are told, you can then swallow a small portion. Then, if no unpleasant effects are noted after a lapse of one, two, or several hours (this depending on which book you have), you can consider the plant safe to eat, at least in small amounts.

Following such instructions can kill you! The root of any species of the water hemlock, *Cicuta,* apparently tastes and smells good to lots of people. The toxin involved will not burn, numb, or sting the mouth, as children have eaten the raw roots greedily, and adults have often eaten them either cooked or raw. Even so, this is the deadliest native plant found on the North American continent, as a piece of root the size of a marble will kill an adult human being within half an hour of ingestion! The poison involved attacks the nervous system and the process of dying is as painful and

unpleasant as can well be imagined, with convulsive seizures so violent that bones are often broken and the tongue is frequently chewed to shreds.

Other plants contain very slow-acting alkaloids that produce no symptoms for twenty-four to thirty-six hours after ingestion, but for which no antidotes or effective means of treatment are known. Still other poisons are cumulative in nature, being dangerous only when eaten in considerable quantity or over a span of time. Any test based on sampling would fail to reveal these hazards.

You must not assume that a plant is safe to use because birds or animals eat it! Squirrels cut and store quantities of the deadliest of mushrooms; bears and hogs eat the deadly death camas with apparent gusto; and birds eat many poisonous berries without apparent harm. Besides, you have no way of knowing that the animal or bird you see eating an unknown plant will not suffer sickness or even death as a result.

There is only one safe way to use wild plants for food: *you must know, positively and beyond doubt, that the plant you propose to eat is edible!* It's a question of being dead certain or of being dead, period. *If you cannot identify a plant as edible beyond all doubt, do not eat it!*

Plant foods vary widely in their nutritional value. Nuts are high in protein and fat content, and are often far richer in calories than most meats. Seeds, inner barks, and roots generally supply starch or carbohydrates. Fruits and edible saps furnish vitamins and calories in the form of sugars, but offer little else. The new leaves and leaf buds of trees and shrubs and the foliage of herbaceous plants are rich in vitamins A and C, but are low in carbohydrates and calories and have almost no protein.

The inner bark or cambian layer of all of the many species of cedar, cypress, fir, hemlock (not the herb!), juniper, pine,

and spruce trees is edible and more or less nourishing, if not particularly appetizing.

The only pinelike evergreen tree (not a member of the pine family) that is in any way dangerous is the yew-wood tree, *Taxus brevifolia.* This tree is usually somewhat shrubby in character, with reddish, shreddy bark more or less like juniper bark. The evergreen needles are flattened, an inch or so long, dark green, very glossy. From a distance, the trees often appear rusty-brown. The fruit is a pale red or pink, barrel-shaped berry that is open at the tip, revealing a dark brown or blackish pit or seed. The pulp of the fruit is not known to be seriously poisonous, but the pit or seed is highly toxic. The foliage of all the Asiatic and European members of this genus is among the more dangerous of plant substances; and no part of the plant should be used as food.

The cambian layer of alder, aspen, basswood, birch, cottonwood, elm, maple, sycamore, and willow is edible and, in some cases, even good. Scrape this layer as a pulp to eat raw, or cook it by boiling or roasting. You can also dry it and then grind or pound it to make a flour substitute.

The inner cores or cobs of green fir and pine cones are edible and somewhat nourishing. You should first pound them to a pulp and then roast them. You can also boil them to produce a nourishing soup. As many of these cones take two or more years to mature, the green cones can be found at any time of the year.

The "berries" of all the junipers (these are actually fused cones) are edible either raw or boiled, but they are far too resinous and strong-flavored to be good. These berries are produced so abundantly that distant trees often appear blue, and they usually remain on the tree throughout the winter.

The catkins of alder, aspen, birch, cottonwood, and willow are edible, as are the tiny staminate cones of pine, fir, and spruce.

The seeds or nuts from pine cones are concentrated energy at its best, containing over sixty percent edible fat. They provide more than thirty-two hundred calories per pound, which is almost four times as much as fresh beefsteak! All pine seeds are edible, but those of the Coulter, digger, Jeffrey, limber, piñon, Ponderosa or yellow, and the sugar pine are the largest and therefore the most useful. The seeds of the lodgepole and knobcone pines are smaller, but are retained in the cones throughout the year (the cones do not open until singed by fire), making them available in all seasons.

The seeds of the true firs, the Douglas fir, and the hemlocks and spruces are edible, but are too tiny to be of much value. Many of the species produce seeds that are acrid or resinous to the taste, but roasting or boiling will reduce or eliminate this quality.

To procure the seeds, lay the cone in hot ashes or on a rock beside a hot fire. The scales will gradually open to expose the seeds for easy removal. You can also fire the cones, but this is wasteful of the seeds, as many will be lost and some will be ruined.

The acorns of all the many species of oak, both deciduous and evergreen, are edible, although all are far too bitter to be eaten raw. Shell the acorns, crush them, and place the crushed kernels in rapidly boiling water. Change the water when it becomes tea-colored. Several such changes will leach out much of the bitter tannin to make white oak acorns almost good, and other types will range from slightly to intensely bitter. Repeat the leaching process with the bitter ones or use a slurry of wood ashes and water instead of just water. You will then have to boil them in plain water to eliminate the lye. An alternative method is to crush the shelled acorns and soak them in cold running water for several days. This was the method used by Indians, who had no

easy way to boil water. Used the leached fragments as with nuts, pulverize to use as flour, or boil for soup.

Beechnuts, butternuts, chestnuts (most chestnuts have been killed by blight), chinquapins, hazelnuts (wild filberts), hickory nuts, pecans, and walnuts are edible either raw or when cooked with other foods. The seeds of the maples and sycamores are also edible. Crushed kernels of these nuts or seeds will yield a cooking oil. *Horse chestnuts and buckeyes are poisonous!*

You will find that squirrels and other animals and birds have harvested most of these nuts long before winter, but scattered nuts can be found throughout the winter by scratching among fallen leaves, You can also raid squirrel or woodrat nests to obtain larger supplies. In some areas, acorn woodpeckers will have stored large numbers of acorns in shallow holes made in the bark of trees, and you can rob these caches.

The winter leaf buds of alder, aspen, birch, cottonwood, maple, sycamore, and willow are edible either cooked or raw, and the young, unfolding leaves of these trees are richer in vitamin C than fresh orange juice. The tender young twigs of all these trees are edible, either as a nibble or as a boiled dish. The unfolding leaves of the deciduous oaks are edible if boiled in two waters.

The tender new needles of the firs, the Douglas fir, hemlocks (the trees), larches, pines, and spruces are edible if not overly tasty, and these yellowish needles are rich in vitamin C. You can eat them raw, mix them with other cooked greens, or steep them to make a vitamin-rich tea.

The wild rose differs only slightly from the plants in your yard and is therefore instantly and positively identified. The hips or fruits remain on the plant throughout the winter and are often found on stems protruding through deep snow. These fruits are the equal of apples in food value, and they

often taste like overripe apples. Three of these hips are said to be the equal of one large orange in vitamin C content, and they were gathered and used in wartime England to replace unavailable citrus fruit. They can be eaten raw or cooked, fresh or dried; but you will need to remove the woolly covering of the seeds in some species.

You can eat both the berries and the young shoots of any of the many species of caneberries. Blackberries, cloudberries, dewberries, lagoon berries, raspberries, salmonberries, thimble berries, and wine berries are included in this category, the genus *Rubus.* These plants are characterized by leaves divided into three to five leaflets and by berries that are made up of many juicy, more or less tasty, one-seeded drupelets. The leaves are edible either as boiled greens or when steeped for tea.

The wild strawberry is identical to the domestic plant but smaller throughout, and the berries are both much smaller and much sweeter. The leaves are very rich in vitamins A and C, and they can be eaten as boiled greens or steeped for tea. The plants are perennial herbs and do not lose their leaves in winter.

Wild cherries are so similar to domestic cherries in all but the size of the fruit that the trees are readily recognized. The seedlings of domestic cherries are widely scattered in wooded and brushy areas and can now be considered "wild." The fruits of seedlings vary widely from tree to tree, with some being almost as good as cultivated varieties. *The fruit of the cherry laurel, widely used for hedges, is not edible!* The chokecherry is a large shrub or small tree that produces small fruits that are astringent or "puckery" when raw, but these are both edible and eatable when cooked. Only the Oregon bitter cherry has small, bright red fruits that are too astringent to be eaten.

Cherries should never be eaten pits and all, and the pits must never be eaten raw! The pits from all members of this genus,

including almonds, apricots, cherries, peaches, and plums, contain cyanide compounds in sufficient quantities to make them extremely dangerous. Only the edible almond, and then only when thoroughly ripe and dry, lacks this poison. Cyanide is highly volatile, and the shelled kernels of cherry and plum pits can be rendered safe by long-term drying, by boiling in two or more waters, or by dry-roasting. Do not eat them in significant amounts even then unless you mix them with larger quantities of other foods.

The many species of wild plum indigenous to North America and all seedling plums also produce edible fruits, but the flattish pits are just as dangerous as those of the cherries. Seedling plums are now well established as wildlings. Their fruits vary widely from tree to tree or thicket to thicket, but are as edible as those from domestic varieties. The bark and foliage are poisonous.

The overly-sweet fruits of the hackberry tree are perfectly edible, and the cherrylike pits contain kernels that are both harmless and good. The pits sometimes remain on the tree for considerable periods after the pulp has sloughed off.

The "Indian plum" or oso-berry of the Pacific Northwest is edible but not overly good, and its pits are also harmless.

Wild crabapples and seedling apples and pears are so similar to domestic types in overall appearance that these trees, too, are readily identified. The fruit of all types is edible, although the taste and quality of seedling fruit is different for every tree. Crabapples, of course, are intensely sour. The seeds contain cyanide in significant amount, but this is a hazard only when the seeds are eaten alone, raw, and in considerable quantity, which few would even try. Eaten with the fruit pulp or when cooked, they present no danger.

The hawthorns are tall woody shrubs or small trees with long woody thorns and variously-lobed leaves. The berries are exactly like small red or black apples, and are edible in

small amount either raw or cooked. The berries contain a non-toxic heart stimulant and should not be eaten in large amount or without admixture. They are borne in tremendous quantity and remain on the tree all winter.

Red and white mulberries are large forest trees that produce tremendous crops of elongated berries that look like dewberries. These and the tender young leaves are edible raw or boiled. The berries are good when dried, and boiled young twigs are rather tasty. Planted by homesteaders, these trees are now sparingly established in the West.

The mountain ash is found in low-growing shrub and shade tree form. All species produce enormous crops of orange to red berries that are edible when cooked in two or more changes of water. The taste (to me) ranges from mildly awful to downright nasty, slightly less so after heavy frosts; but some people regularly make jelly from them. The pea-sized berries are in dense terminal bunches and remain on the bush or tree until well into winter. Plentiful when found, these berries are too unpalatable to most people to be very useful as emergency food; but you should at least try them. "One man's meat is another man's poison," after all, and you might even like them.

Blue or black elderberries are good either raw or cooked, fresh or dried, although the blue ones have to be washed to free them of a dense white powder that nauseates some people. The flowers are also edible, but the foliage is not. The red elderberry produces bright-red berries that are reputed to be mildly poisonous, although this is frequently disputed; and some Indian tribes are said to have used them for food. Elderberries are found as large, clustered shrubs or as very small trees. The foliage and bark are toxic, but mildly so.

The madrona grows at low to moderate altitudes from California to British Columbia on the west side of the Cascades, and another species grows in Arizona and New

Mexico. The tree is identifies by its polished red or reddish-yellow bark that peels and shreds in rolled tubes and its dark-green evergreen leaves. It produces terminal bunches of urn-shaped, white, sweet-scented flowers and bunches of half-inch orange or reddish-orange berries that look like rough-skinned oranges. Both the flowers and the fruit are edible when cooked, but few would call the berries good. Berries remain on the tree well into winter when not consumed by birds.

The manzanitas are similar to madrona in many ways, but they are always in sprawling or bush form. They are characterized by grayish-green evergreen leaves (two far-northern species are reluctantly deciduous) and brick-red to scarlet bark that is always flaking and peeling. The flat to round berries look exactly like tiny apples (*manzanita* is Spanish for "little apple") and are edible either raw or cooked. The urn-shaped pinkish flowers are also edible.

Kinnikinnic or bearberry manzanita is a sprawling, vine-like shrub with bright-red, round berries growing in clusters beneath the leaves. This is a high-altitude and circumpolar plant (it also grows along the immediate coast) and the berries remain on the plant all winter and well into spring. The dried leaves make a tea that is effective in the treatment of urinary infections or irritations. An interesting but harmless side effect is green urine! Dried leaves have long been used as a replacement for or as an adulterant of tobacco. Berries and flowers are as edible as in the many other species and the berries are valuable emergency food because of the plant's chosen habitat and their longevity.

The service berries (pronounced "sarvice" by many) are large shrubs or small trees with round or oval, bluish-green leaves that are smooth-edged near the leaf stem but sharply toothed near the tips. The berries are round or slightly elongated, blue or purplish, and have five dried-up, petallike pro-

jections on the end opposite to the stem. These berries are both edible and good whether raw or boiled, fresh or dried, and the foliage is edible as boiled greens. This was the berry the Indians normally mixed with pemmican or dried in large cakes for winter use.

The Oregon grapes grow as sprawling, prostrate shrubs, as single stems with spreading tops, or as upright, densely clustered shrubs to eight feet tall. All have spined evergreen leaves very similar to Christmas holly. The berries are blue, black, or dull-red, usually covered with a white, waxy powder, in large terminal bunches. These berries are too acidic to be good when raw, but they are perfectly edible when cooked, and they make a splendid additive to nonacid berries or fruits. The red-berried types and the smaller species of the blue-berried types are thought to produce the best-flavored fruit.

The jet-black crowberries are edible either raw or cooked. The plant is a sprawling evergreen shrub with short, needle-like leaves. It is common and abundant in Alaska and Canada, and extends southward along the immediate coast to northern California. The berries have a medicinal flavor, but this is not strong enough to be really unpleasant. The berries remain on the plant throughout the winter and are plentiful enough where found to make it worthwhile to dig through snow to get them.

The eastern blueberries and the western huckleberries are easily identified. The blue, black, and dull-red types are delicious; and the bright-red ones produced on very tall bushes are as good or better than these. The bright-red cranberries borne by a creeping vine in bogs and marshes and the red lingonberries found on low-growing bushes in drier surroundings are much too sour to be enjoyable raw. Cooked with a liberal admixture of sugar (salt reduces the amount of sugar needed) or other sweetener, these berries are very good

indeed. These two are the berries of commerce. Both occur in tremendous abundance where found and remain on the plant all winter.

The salal is a low and tangled or thicket-forming shrub that forms dense jungles in coastal areas and grows in forested areas west of the Cascades from Alaska to California. It is characterized by long-oval, shiny-green, evergreen leaves and tough zigzag stems that have earned it the name of "shin tangle." The flowers are urn-shaped, pink or white, in fragile, one-sided clusters at the branch and stem tips; and both these flowers and the soft white flower stem are edible. The berries are bluish-black, barrel-shaped, tough-skinned, hairy, and very juicy, and are edible either raw or cooked, fresh or dried. They occur in tremendous quantity. The foliage is also edible.

Two smaller versions of the salal are found at high altitudes in the western mountains. Both have trailing, zigzag stems that are often buried by forest duff or old grasses, and these put up slender stems to six inches tall or less that are clothed in dense, reddish hair. They are found in thin woods but also grow well and bear prolifically in open alpine meadows where these are damp but not soggy. The leaves are evergreen and the pea-sized berries are red and white, much like tiny Rome Beauty apples. the whole plant is wintergreen scented and both the berries and the foliage are edible.

All of the wild honeysuckles produce berries that are edible in the sense that none are poisonous, but several species have berries that are excessively bitter. These are climbing or trailing vines or densely clustered shrubs, bearing flowers and fruit either in pairs or in terminal clusters.

The viburnums or high-bush cranberries are clustered shrubs with leaves much like shallowly lobed maple leaves. They bear terminal clusters of showy white flowers (the

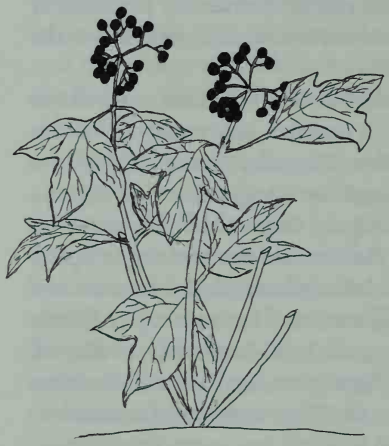

Figure 17: Viburnums

"Snowball Bush" is a variety with sterile flowers) and enormous numbers of fruits, each containing a single, flattish, plumlike pit. The meat of these "berries" is very thin and has a rather unpleasant odor; but this meat is edible and not at all unpleasant when boiled, and is even good raw when the fruits have been thoroughly frosted or frozen. These fruits remain on the bush all winter, long after the leaves have fallen, often providing a splash of color where the branches protrude through snow. (See Figure 17.)

All of the many species of currant or gooseberry produce edible berries in the sense that none are harmful or poisonous, but some of these are so sticky-glandular, have such an unpleasant odor, or taste so bad that you could not eat them, at least when raw. Don't judge the quality by a single taste, as fruit from bushes a hundred yards apart may vary considerably. These berries are amber, red, black, or greenish, and are characterized by a dried-up tubular flower that clings to the berry. All of the species have shallowly lobed leaves like those of a maple.

The dwarf dogwoods are herbaceous plants with a single whorl of pointed, broad, lance-shaped leaves just below the tip of the six-inch stem. The inconspicuous flowers are surrounded by white bracts that appear to be petals, just as with

tree dogwoods. The dense clot of red or purplish-red berries grows at the very tip of the stem. The plants often grow so thickly that they blanket large areas of forest floor, and the berries can be gathered in good quantity. They can be eaten either cooked or raw, but are not overly good when raw.

The cascara or chittum tree produces black, cherrylike fruits with several seeds. These are edible if not overly tasty, but they have a cathartic effect on some people. At least one recently published book lists them as poisonous, but I began eating the raw berries at age fourteen and I am now seventy-two! I don't like them well enough to eat them in quantity, however. The Northwest Indians apparently ate them in large amount. This is the cascara sagrada, the "sacred bark" of the Spanish, and the bark has long been used in the preparation of commercial laxatives. The tree is readily identified by its whitish bark and the deeply impressed parallel veining of the leaves.

The false Solomon's seal is a slender, arching plant rarely over two feet tall, with a double row of lance-shaped, stemless leaves. It bears a terminal raceme (elongate cluster) of small, translucent red berries that are often dotted with darker red. These berries are edible either raw or cooked, but are purgative to some people. The Indians of the Northwest also dug the large root, soaked it in a solution of wood ashes and water for twenty-four hours, then parboiled it to rid it of the lye. They then cooked and ate it as a vegetable.

The roots of the many species of balsamroot are edible when cooked, the young stems are good either raw or as cooked greens, and the seeds are among the most delightful of wild foods. The mule's ear or compass plant is very similar in appearance, and the roots are edible when baked or when boiled in two waters. No one would call them good. (See Figure 18.)

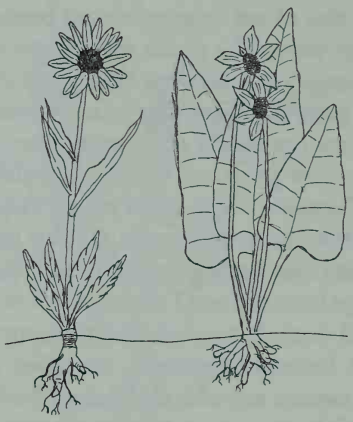

Figure 18: Mules' ears and balsamroots

All of the many species of mariposa lilies and cat ears have edible and nutritious bulbs, although some of these are too small to be of much value. The entire aboveground plant, though sparse, is edible as cooked greens. Many of these are dry-area plants, growing in the sagebrush areas of the West and to seven thousand feet in the mountains. Other species grow on the fringes of the Western valleys and in open glades in the forested mountains of the Northwest. Others are found in the deserts of the Southwest. They all have three broad petals and three smaller, straplike sepals that may or may not be brightly colored. The larger and more colorful of these are known as mariposa tulips, and several small species are known as cat ears because of the thickly-haired interiors. (See Figure 19.)

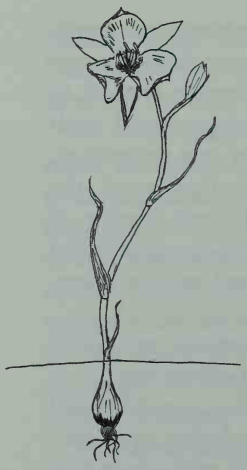

Figure 19: Mariposas and cat ears

All of the many native species of riceroot lilies have edible bulbs, these thickly covered with fat, ricelike granules that distinguish the bulbs from all others. These plants exist in widely

varying habitats and themselves show marked variation within a species. In some species, the features are so inconsistant as to make it nearly impossible to accurately describe them. All species are recognizable either by the shape of their flowers or by the peculiar splotching that is the outstanding feature of all but two of the species. (See Figure 20.)

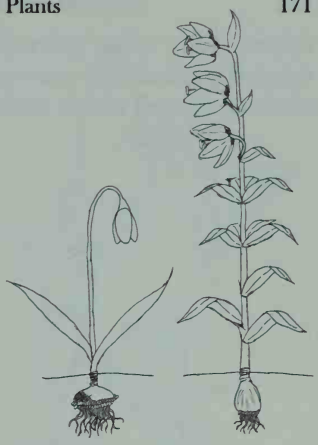

Figure 20: Riceroot lilies

All of the dogtooth violets, also known as lambtongues, fawn lilies, trout lilies, avalanche lilies, glacier lilies, etc., have edible corms (bulbs), and the stems, leaves, buds, flowers, and seed pods are also edible. These plants have two very long, lance-shaped leaves that are marked with white or brown splotches in some species, unmarked in others. These are fused to the wiry scape (flower stem) below ground level and pull up with it. The flowers are six-petaled (actually three petals and three identical sepals) and come in a variety of

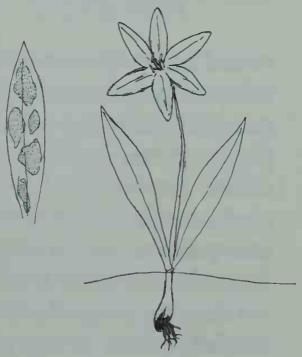

Figure 21: Dogtooth violets

colors. They often grow so profusely that they carpet acres of ground, and one variety or another is found from sea level to well above timberline. (See Figure 21.)

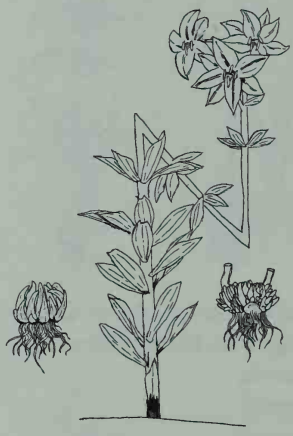

Figure 22: Lilies

The true lilies are tall, stately plants with solitary stems rising from deep-seated, scaly bulbs. The leaves are long and tapering, either in whorls or scattered along the stem. The flowers are deep trumpet-shaped, often spicily scented, very showy, and variously colored. The bulbs and all other parts of the plant are edible either raw or cooked, and the buds and flowers are considered delicacies in Asia. (See Figure 22.)

The cluster lilies have thin, wiry stems springing from very deep-seated, fibrous-coated bulbs. The leaves are few, all at ground level, like flat blades of grass in some species, distinctly **U**-shaped in others, generally withering before the plants bloom. The flowers are papery in texture, six parted, the identical petals and sepals united into a tube for at least half their length in most species, each on a thin stem, these all springing from a common point at the tip of the main stem, but in some cases so short that the flowers are in a ball-like cluster. The flowers are blue, purple, yellow, red and green, two-tone blue, pinkish blue, white, or any off shade of these, with petals often striped with contrasting colors on the midveins. The stems range from six inches to nearly eight feet long in the various species and are sometimes looped or kinked. The bulbs are

very deeply buried, often in hard-baked ground, and are very hard to dig. They are delicious either raw or cooked, and are often called "grass nuts." The unripe seed pods are edible when cooked. (See Figure 23.)

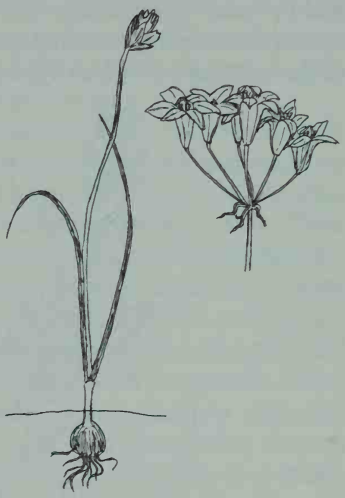

Figure 23: Cluster lilies

The wild onions (and wild garlic) are very similar to cluster lilies in overall appearance, but have the distinctive onion or garlic odor. Anyone with a normal sense of smell cannot fail to identify them by the odor alone. Like their domestic cousins, the entire plants are edible either cooked or raw. (See Figure 23.)

The edible camas has single, leafless stems to thirty inches tall (usually twelve to eighteen inches) growing from bulbs as much as two inches in diameter. The leaves are like blades of grass but thicker, flat or nearly so, often powdered, all from the base except for a modified leaf-like bract at the base of each flower branch. The flowers are a flattened bell-shape, from one and a half to more than two inches wide, generally pale blue to deepest blue-violet, but with occasional pure-white specimens. One southern Oregon variety has cream-colored flowers. The plants grow in moist meadows or wherever the ground is very damp or wet until late into spring. The bulbs were one of the most important foods of western Indians, and are still in regular use by some tribes

and by some non-Indians. You can cook them by boiling, baking, or roasting, but they taste best (to me) when roasted in the ashes of a fire. (See Figure 24.)

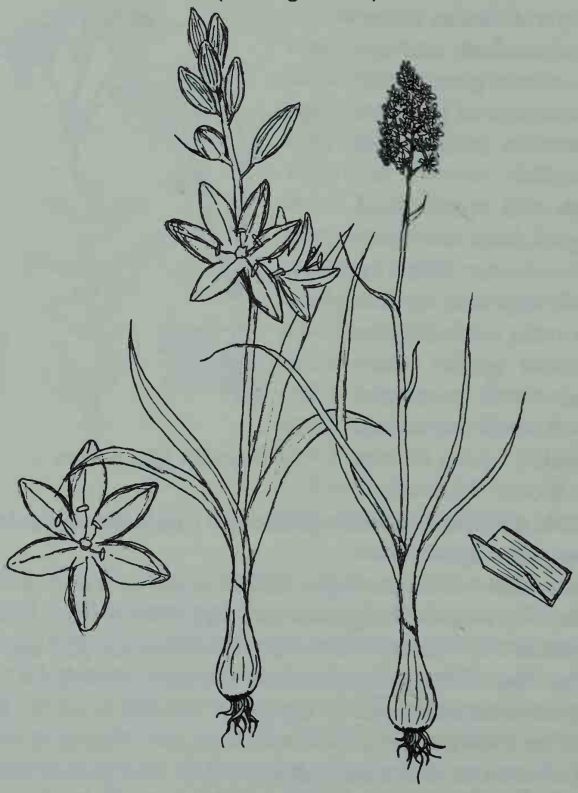

Figure 24: Edible camas

Figure 25: Death camas

Beware the death camas! This deadly member of the lily family shares the range of cluster lilies, the wild onions, and the edible camas; and it has been collected and used in place

of all three, often with fatal consequences. There is really no excuse for such carelessness, as the resemblance between these plants and any of the edible threesome is very superficial and the differences are distinctive.

The death camas has grasslike leaves that are sharply keeled or **V**-shaped, and these are very harsh and raspy on the thin edges. Though most leaves are basal, the plants often have two or three definite leaves on the erect stem. These leaves often enclose the stem for a considerable distance in a parchmentlike sheath. The flowers are borne in a dense raceme in which each flower is at the tip of its own threadlike stem, these arising at separate points along the upper end of the main stem. One species has flowers in a panicle, where each of these secondary stems is branched. As with any raceme, the bottom flowers open first, often before the topmost buds change color, and the blooms open in a steady upward progression. The flowers themselves appear to be six-petaled (three identical petals and sepals), and are rarely more than half an inch in diameter. They are saucer-shaped, white with a definite yellowish or greenish tinge that is created by yellow or green claws or glands at the base of each petal. (See Figure 25.)

Both cluster lilies and onions have flowers that terminate in thin stems that rise from a common point, like the ribs of an umbrella. The stems of both are leafless. The flowers of the cluster lilies are more or less in the shape of a tube with a flaring mouth, and no glands are in evidence. The onions have flowers that are trumpet-shaped to bell-shaped and without glands. The onions always have the distinctive odor.

The edible camas bears its flowers in a raceme, as does the death camas; but the flowers are not at all similar. The blooms of the edible camas are shallow-bowl to saucer-shaped, from one and a half to more than two inches across, and would flatten to an even wider diameter. These flowers

range from washed-out blue to deepest violet, although one variety in the Umpqua Valley of Oregon is creamy-white. Pure-white specimens occur in all species. The leaves are like thickened blades of grass, flat or nearly so in cross-section, are often powdered, and are smooth edged. As with the cluster lily and onion, the petals are without glands, remaining thin to the base.

Attention to detail is vital! Anyone who uses the death camas by mistake does not die from poison. He dies from ignorance or carelessness! You would not mistake lettuce for cabbage in a store. No more should you confuse death camas with any other plant!

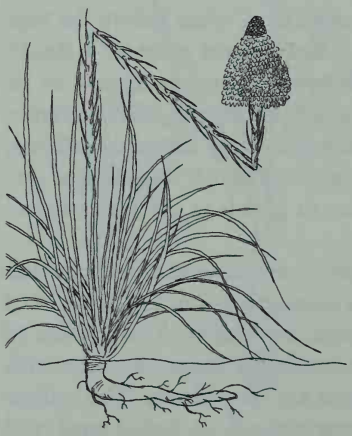

Figure 26: Bear grass

Bear grass is an odd member of the lily family found at moderate to high altitudes in the western mountains. It has tall, erect stems rising from dense mounds of long, thin leaves (one-quarter inch wide and up to eighteen inches long) that often cover large stretches of ground to the near exclusion of other plants. These leaves are extremely strong and were much used by the Indians for basket making. The stem is covered with shorter leaves lying flat against the surface. The flowers are white, tiny, and highly scented, in a dense terminal cluster somewhat to strongly onion-shaped. The rhizomes are much like those of the domestic iris, often partially exposed, and are

edible when cooked in two or more changes of water. You can also wash your person or your clothing in the first water, as the saponin extracted by the hot water creates quantities of "suds." The peeled stems are edible when boiled with other greens. The plants are identifiable in winter. (See Figure 26.)

One of the mainstays of the Northwest Indian diet was the "*wokas,*" or yellow pond lily. These plants grow in still water, and the large pads or leaves often completely blanket the surface of ponds or shallow lakes. The large, cylindrical roots are edible when roasted or when ground into meal, but they are not at all tasty to me. The seeds, too, can be ground for flour; but they also make an acceptable substitute for popcorn! Bring the seeds to high heat in a dry or lightly oiled pan, just as you would with popcorn. They will not explode with the same glorious abandon as popcorn, but they will pop open; and the meat can be winnowed from the cracked shells. To secure the seeds, break open the hard seed pod or soak a mass of them in a container or a pit full of water to soften them. When you extract the seeds, you will find each one firmly attached to a "floater." Simply dump them into a container of water and set it aside. The floaters will all detach themselves from the seeds and allow the seeds to sink, usually within twenty-four hours. (See Figure 27.)

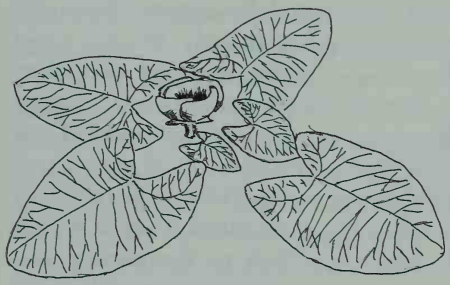

Figure 27: Wokas

Another highly valued food among the Indians was "*wapatoo,*" or arrowhead tubers. The several species are aquatic plants, growing in water or in oozy mud. They have large, shiny-green, long-stemmed leaves shaped much like arrowheads, and a tall, robust stem with filmy-white, three-petaled flowers in groups of three. The roots are thin and stringlike and bear numerous potatolike tubers. These can be used in any way that potatoes are, but they should be cooked somewhat longer than potatoes of the same size.

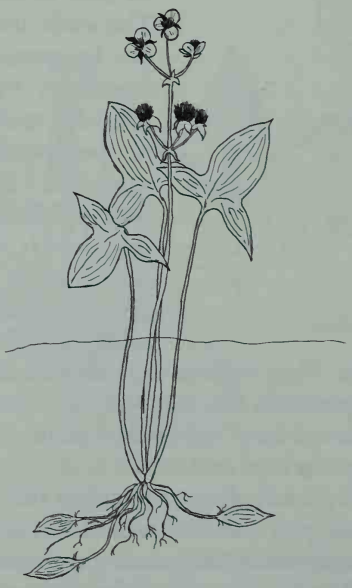

Figure 28: Wapatoo

The Indian women gathered the tubers by wading chest deep in the chilly waters of late fall and early winter, hanging on to the sides of an empty canoe. They located and worked the tubers out of the bottom mud with their toes. The detached tubers would bob to the surface, and the women would collect them and toss them into the canoe. A simpler and less Spartan method is to rake the mud to a depth of several inches and to a distance of two to three feet around a plant, stirring vigorously to both dislodge the tubers and free them of clinging mud. Use a stout, well-branched limb or pole as

a rake. You can make a miniature log boom by tying floating sticks together to corral the tubers and prevent them from floating beyond your reach. (See Figure 28.)

The common and ubiquitous cattail is a veritable market basket of edible products. The ropelike rootstocks are shallowly buried in a tangled mat in the mud of pond bottoms and in ditches and marshes. Dig or dredge up a number of these roots, peel them of their spongy rind, and crush the cores in a container of water. Work the fibers out of the cores with your fingers and allow the starch to settle. Pour off the water and refill the container, then stir up the starch and let it settle again. Repeat as often as you wish, refining the starch to your own satisfaction. The final result is a fine flour, every bit as good as that ground from grain.

You can also extract this flour, though not in as high a quality, by boiling the peeled roots to a gruel and straining out the fiber; by drying the peeled roots, roasting them, and shaking out the dry starch; or by cooking the peeled roots and chewing them to extract and swallow the starch and spit out the fibers. It is even possible to cut the peeled roots into thin slices or bite-sized chunks, cook them, and eat them, fiber and all, as a vegetable.

Each node of the creeping roots puts forth a sort of sheathed bud that will be next year's plant. Each of these buds contains a delicate, starchy kernel much like a nutmeat, and these are delightful when cooked in a meat stock. They are also good raw, but should not be so eaten if their growth site might be polluted or contaminated.

When the plants are still young (before the stalk emerges), you can grasp the clump of leaves and with one firm yank break the plant away from the root. The inner leaves and the base from which they grow are white, tender, and fragrant, and are among the most delicate and tasty vegetables the wild affords. This product is used nearly throughout the

world, and is usually known as "Cossack asparagus." The seed heads of cattails make a very good substitute for corn on the cob when collected before ripening. They tend to be somewhat dry, but are both nourishing and tasty. The pollen stalk that surmounts this head becomes thoroughly coated with fluffy golden pollen during the blooming season, and this pollen is useful as a flavorful and nutritious flour. Even the countless tiny seeds can be used as food in a real emergency. Gather the ripened heads and burn them on a flat rock or other hard and nonflammable surface. The down will be burned away, leaving large numbers of preparched seeds to be sifted from the ashes. No one can go hungry when cattails are available.

Bullrushes or tules also have edible roots. These are marsh plants, ranging from a few inches to more than eighteen feet tall in the various species. The leaves in most species are reduced to pointed sheaths. The plants have stems that are oval, elliptical, or triangular in cross section, and they are easily and positively identified. The roots can be eaten either raw or cooked, but should be thoroughly cooked because of pollution hazards.

The common reed is another marsh plant that produces edible roots, and the whole plant can be eaten. It has stems to twelve feet tall, leaves to one inch wide and eighteen inches long, and great plumy heads like hairy corn tassels. The young stems and leaves are useful as cooked greens and the older stems (before blooming time) can be ground into a very sweet flour.

Even the western skunk cabbage has roots that are edible when properly prepared. This plant has enormous round-oval, shiny-green leaves, giving it the appearance of a tropical plant, although it favors cool bogs and marshy ground. *The leaves are all from the root.* The flowers are tiny and greenish, on a clublike spike held within a flame-yellow

cloak or spathe. The whole plant is very rank-scented, and it does indeed smell "skunky." The roots are very thick and fleshy, buried deeply in wet or watery muck. Both these roots and, to a lesser extent, all other parts of the plant contain needlelike crystals of calcium oxalate, a nonsoluble acid. These penetrate the tender tissues of the mouth, tongue, and throat when eaten without proper preparation, and produce a painful burning and choking sensation.

This acid is not water soluble and is unaffected by boiling, no matter how often the water is changed. It is volatile,

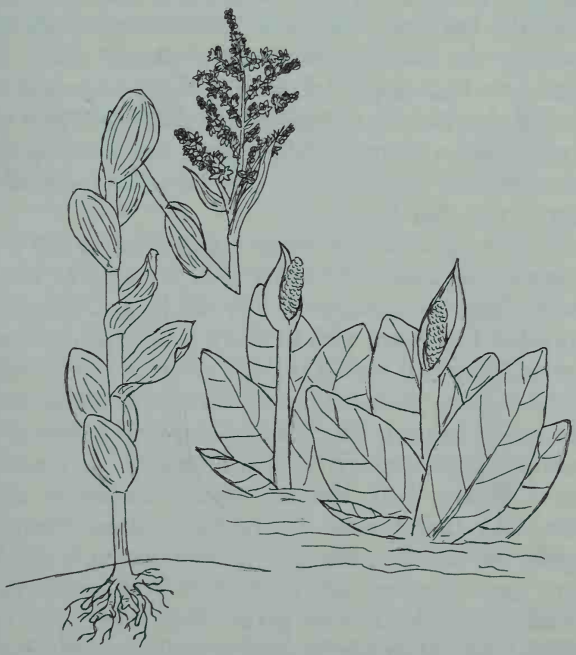

Figure 29: False hellebore (left) and Skunk cabbage (right)

although reluctantly so, and either long-term drying or thorough roasting will eliminate all traces of it. When baked in an underground pit for not less than thirty-six hours, the roots are very good indeed; and the air-dried leaves are also good. These plants are readily identified, occur in tremendous abundance where found, are widespread, and are available from early spring till late fall. They are therefore a valuable source of emergency food. (See Figure 29.)

CAUTION: *The tall, leafy-stemmed plant that grows in boggy or wet situations is not skunk cabbage,* although I have seen it so identified in some books. It is instead the poisonous false hellebore, *Veratrum,* and all parts of the plant, especially the blackish roots, are virulently toxic! These plants have boat-shaped leaves with deeply-impressed parallel veins that look like seams in boat planking. These leaves all grow from a common stalk or stem. *Skunk cabbage has no such stem, each leaf having its own stem that comes directly from the root.* (See Figure 29.)

Silverweed, while not a true marsh plant, is still partial to damp soils, especially where these are salty or alkaline. These plants are distinguished by the long, trailing leaves formed of a midstem with as many as twenty-one sharply-toothed, long-oval leaflets that are green on top but silvery on the bottom, these interspersed with tiny leaves that are otherwise identical. The plant spreads by means of red, strawberrylike runners, and the single, hairy-centered, yellow flowers look like strawberry blooms in all but color. The fleshy roots are delicious when fried, only slightly less so when baked or roasted, having a delightful nutty taste. They are also good when boiled, then tasting (to me) more like a sweet potato than a nut. The entire above-ground plant can be used as cooked greens, but the dryish, hemispheric fruit is scarcely edible. The plant grows luxuriantly along the immediate coast, occurs in suit-

ably damp and saline areas in the sagebrush deserts, and reaches very high altitudes in the mountains. It is found nearly throughout the continent, even growing well in the Aleutian Islands. Because of its wide distribution, the ease of identification, and the abundance of the plants where found, this is an ideal emergency food source. The delightful taste is a bonus.

Chufa or nut grass is also partial to damp soils, but it is much less tolerant of salinity or alkalinity than silverweed. It is a sedge, not a grass, and has stout, clustered, triangular stems rising from a clump of grasslike leaves that are usually as long as or longer than the stems. The stems are naked except for a cluster of small leaflike bracts just below the flowers, which are yellowish and tiny, in double rows on the several spikelets. The thin roots produce numerous nutlike tubers, and these are among the tastiest of wild foods. They can be eaten out of hand, roasted and used as a coffee substitute, or cooked by any chosen method to be used as a main dish. The plants have been grown for food throughout the world, and they now occur as escapees almost anywhere from sea level to moderate altitudes in all but the colder and drier parts of the continent. When growing in sandy or loose-soil areas, these are a valuable food source, but digging the tubers from harder soils would expend more energy than you would gain. (See Figure 30.)

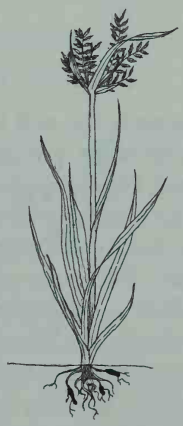

Figure 30: Chufa

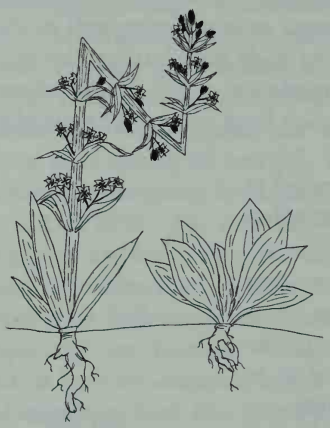

Figure 31: Elkweed

Elkweed or deer-tongue is distinguished by its enormous long-oval leaves and its peculiar flowers. The stem is very stout and erect, smooth to faintly scaly/raspy, and grows to seven feet tall, with whorls of leaves like giant willow leaves (narrowly elliptical). These are dwarfed by the basal leaves. These are also shaped like willow leaves but are widest at the tip, are as much as twenty inches long and four inches wide, and have deeply impressed parallel veins. The flowers are greenish-white, edged with purple and dotted with violet, on short stems in the upper leaf-stem junctions. The very large taproot is edible either boiled, roasted, baked, or fried, with those from stemless plants being much the best. The tender young leaves and the younger stems are also edible as cooked greens. These plants are found at high altitudes in the Rocky Mountains and their subsidiary ranges, often forming dense colonies. (See Figure 31.)

The evening primroses all have edible roots. These plants have trumpet or saucer-shaped, four-petaled flowers that are bright yellow, pink, or pure white, large and showy in most species. The unopened buds are conspicuous, usually reddish in color. The plants are stemless or nearly so in some species, but several of the more common types have stems to two feet tall, these densely covered with whitish or reddish hair. The roots are carrot-form,

large for plants of this size, and are very tasty either baked, boiled, or fried. The roots of younger plants are best, as older roots become somewhat peppery. The leaves make good greens. (See Figure 32.)

The burdocks have thick/fleshy roots that are edible. These are biennials, the first-year plant being a clump of rhubarblike leaves on long, purplish, **U**-shaped stems. The second-year plant has a large and leafy stem that can be peeled and sliced (before the blooms open) to be boiled or even fried like sliced potatoes. The leaves and their stems can be cooked as greens. All of these products taste best if first parboiled, and a dash of baking soda (you can substitute white wood ash) added to the first water improves taste still further. These roots are sold in produce markets in Asia. (See Figure 33.)

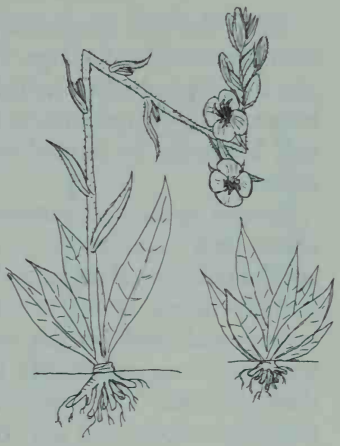

Figure 32: Evening primrose

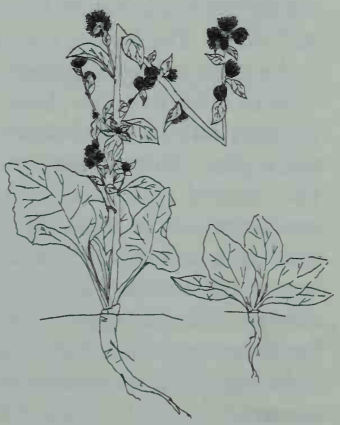

Figure 33: Burdock

All of the true thistles have edible roots, these generally carrot-form and quite large. The peeled stems are also edible and rather good when boiled, and the despined, unopened buds and the disarmed leaves make good greens. The downy seed heads can be burned and the seeds gathered as with cattails.

Several species of sunflower have edible roots, these either fleshy rootstocks or actual tubers. The Jerusalem artichoke is one of these, and it produces large numbers of knobby tubers as big as potatoes. These are somewhat watery, and they are not very good (to my taste) when fried, but some people like them as well as or even better than potatoes. You can boil them, bake them, or even grate raw tubers and use them raw in a salad. They are nonstarchy but are highly nourishing, and even a few plants will provide a large supply. As with all sunflowers, the seeds are nutritious, and the immature seed heads, or the flower heads before or during blooming, can be boiled and eaten. The leaves, too, are edible when cooked. This is the most valuable species, but check out all of them.

Both the bracken fern and the sword ferns have starchy, fibrous roots that are edible. Boil the roots to a thick gruel, then strain out the fibers. You can also dry the crushed roots and shake the powdery starch into a container, or can even chew the cooked roots to swallow the starch and spit out the fibers. The roots can also be cut into small chunks, boiled, and eaten as a vegetable, but they are hard to digest. The young, coiled fronds of the bracken can also be cooked like asparagus spears, although they more nearly resemble okra in taste and texture.

The common and the alpine bistorts produce edible roots. These are members of the knotweed family. They are found in wet meadows or other damp and unshaded areas at mod-

erately high to very high altitudes. Both produce a single zigzag, reddish stem with a few smallish leaves, but the main leaves are from the base. The leaves are smooth and hairless on top but hairy or fuzzy on the bottom, somewhat brownish, shaped much like blades of grass but normally only three inches or so long. The flowers are tiny, white or pinkish, strong-scented, in a dense terminal spike. The alpine bistort has a number of small bulbets clasped against the stem by brownish scales, these occurring just below the spike. (See Figure 34.)

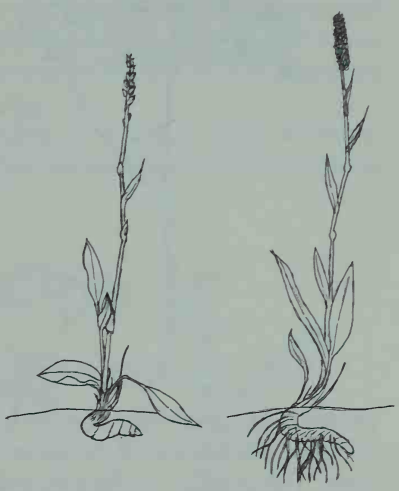

Figure 34: Alpine and meadow bistort

The carrot or parsley family produces some of the finest wild food plants and some of the deadliest plants to be found on this continent. The whole family is characterized by, and is named for, the distinctive flower structure. The flowers are in double or compound umbels, in which a number of primary flower stems (rays) grow from a common point at the tip of the main stem or its branches. Each of these rays bears at its tip a number of smaller branches (pedicels), also arising from a common point, each bearing a single flower. While the entire head and the secondary umbels may be

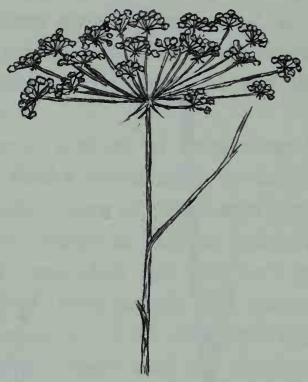

Figure 35: Compound umbel

domed, saucer-shaped, cup-shaped, or nearly spherical, or may be straggly and disorganized, the basic structure remains the same. In all cases the heads resemble an umbrella with each of the ribs bearing a smaller umbrella at its tip. (See Figure 35.)

The wild carrot is a common and very widespread weedy pest, often taking over unused fields, roadsides, or other uncultivated "waste areas." It is now being found at moderate altitudes and in primitive areas. The plant is a biennial, producing only a clump of finely dissected foliage the first year, flowering, fruiting, and dying the second year. In its first year, it forms the familiar taproot, which makes its cultivated descendant so valuable as a food plant. This root is much smaller and woodier than in the domestic plant and is white rather than yellow; but the taste, odor, and edibility are the same. Use them either cooked or raw, just as you would with the garden-grown ones. The tall second-year stem bears numerous saucer-shaped, white or pinkish heads that are so lacy and delicate that the plant is widely known as "Queen Anne's Lace." An interesting feature of this flower head is a small purple flower, otherwise identical to the rest, at or near its center.

The heads after blooming assume a cup or goblet shape, and the seed heads are then widely known as "birds' nests." This structure clasps the seeds so tightly that some of them

remain with it until the rays disintegrate. These seeds can be steeped to yield a fragrant, spicy tea that is said to be strongly antiflatulent, and they can also be used to flavor other foods.

Remember that the wild carrot is distinctively and strongly carrot-scented throughout, and all of the stems, including those of the first-year leaves, are solid or almost so, and are strongly bristly-hairy.

The poison hemlock, *Conium,* is said by many writers to resemble the wild carrot, but this resemblance is so superficial

Figure 36: Poison hemlock

and the differences so distinctive that it is hard to see how anyone could confuse one for the other. The poison hemlock is much taller than the wild carrot (four to ten feet as opposed to one to four feet), has hollow, thin-walled, purple-splotched stems that are very smooth and polished and covered with a white powder. The first-year plant produces only a clump of lacy, fernlike leaves; but the leaf stems are powdered, polished, and purple splotched. The plant is extensively branched near the top and is roughly shaped like a tall hardwood tree in skeletal structure. (See Figure 36.)

No one with a normal sense of smell could fail to separate them on that basis alone. The carrot is strongly carrot-scented, while the poison hemlock has a distinctly unpleasant musty or "mousy" odor.

The cow parsnip is a tall (to ten feet, but usually four to five feet), stout-stemmed plant. The ridged stems are hairy or woolly, and are often marked with red or purple splotching. The leaves are very large, three-parted, with the leaflets shaped like maple leaves. The heads are white, shaped like and sometimes as large as a dinner plate, with conspicuously larger flowers around the perimeter. The plants grow in dense colonies in permanently damp areas, but are found in stunted form even on the gravel shoulders of highways. They occur from sea level to high altitudes and grow along streams even in some semiarid desert areas. Both the large turnip-shaped roots and the peeled stems are edible when cooked, and some Indians ate the peeled stems raw. I find the taste unpleasant, but tastes differ. I would not hesitate to use them in an emergency.

The desert parsleys are generally low-growing species with dissected, carrotlike leaves, but several species grow to three feet or so tall and some have elliptical or long-oval leaflets. The flowers are white, yellow, pink, salmon-col-

ored, or purplish. These are mainly dry area plants, being found from sagebrush deserts to high, barren, stony mountain ridges. All have large, fleshy roots that are edible when cooked, and the foliage is also edible as cooked greens. One species, known as Indian parsnip, pestle parsnip, or Indian celery, has top-shaped knobs at the tips of the main stem and the rays; and these are spicily pungent, more or less like dill. Its stems, once the seeds have begun to form, have a taste very similar to that of celery. (See Figure 37.)

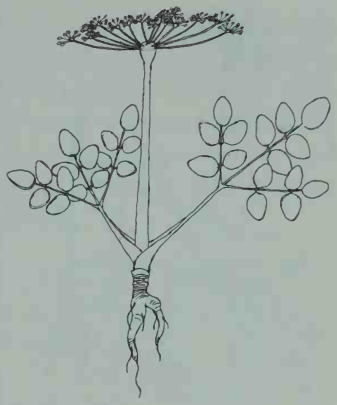

Figure 37: Desert parsley

The Indian potato, also known as turkey pea, is a small and low-growing plant with leaves divided into three leaflets like short grass blades, the whole resembling a turkey track. The flowers are white, in an irregular head. The radishlike root is very tasty either raw or cooked, and the foliage is edible as a cooked green. This, too, is a desert plant, found in dry sagebrush areas or on barren mountain ridges.

The yampah is a slender plant to two or three feet tall, with a smooth, hairless stem and leaves divided into narrow leaflets much like blades of grass (one species has oval leaflets). The lower leaves die well before blooming time, leaving the lower stalk naked. The flowers are white, in more or less dome-shaped umbels, with the secondary umbels being almost spherical. The roots are carrot-form, usually two but sometimes one or three, and are among the most delicious food roots, either wild or cultivated, that are

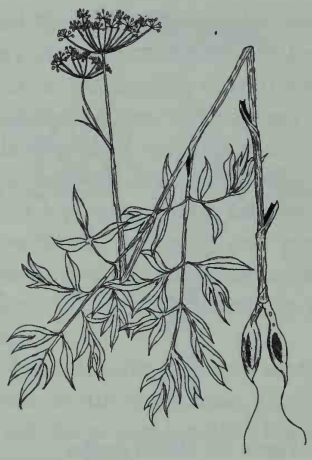

Figure 38: Yampah

known. They grow in the driest of sagebrush areas but are also found at considerable altitudes in dry mountain meadows. They resemble *Cicuta* in having multiple roots, in having smooth, hairless stems, and in the color of the blooms; but they are never powdered, never marked or spotted with red or purple, and they are never found in marshy or permanently wet areas. (See Figure 38.)

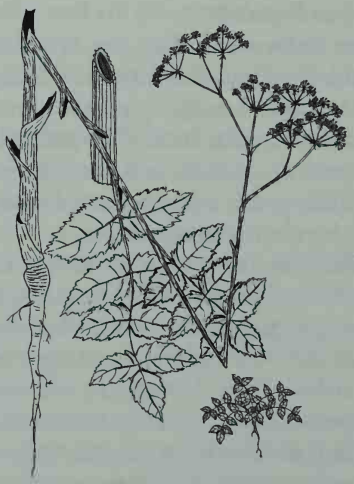

Figure 39: Wild parsnip

Wild parsnip in its first year produces only a clump of leaves and the familiar white, carrot-form root, this differing from the cultivated root only in being somewhat smaller and woodier. The leaves are composed of a midstem with a number of oval or egg-shaped leaflets, these sharply toothed and sometimes cut or lobed. In its second year it is a tall, robust plant (to five feet tall) that has sharp, almost

knife-edged vertical ridged on the stem. The flowers are yellow, in flat to dome-shaped heads. You will have heard that this plant is poisonous, but such reports are based on a simple confusion of identity. Dozens of plants in this family have the word "parsnip" as part of their common name and when someone says "wild parsnip" he may actually be referring to any one of several plants. (See Figure 39.)

The roots of the several species of *Cymopterus* are also known as Indian parsnip or wafer parsnip. These plants have no leaf-bearing stem, the lacy, finely dissected leaves all growing from the base, and the short flower stems bear variously shaped heads of white flowers. The root is deeply buried, putting forth an underground stem (a psuedoscape) to reach the surface, and is usually somewhat largest at its lower end. These roots are edible either raw or cooked when very young, and are edible if cooked in two waters when older. The foliage should not be eaten. (See Figure 40.)

Figure 40: Wafer parsnip

The water hemlocks, *Cicuta,* are the deadliest native wild plants found on the North American continent. This is a wet-area genus, the plants growing either in water or in permanently saturated ground. The stem is hollow, thin-walled, jointed, smooth and polished, powdered, often but not always marked with red or purple, to ten feet tall, but usually four or five feet. The flowers are white or greenish-white, very showy, in dome-shaped to almost spherical heads.

The leaves are to three feet long, compound, composed of a midstem and several branches, each bearing a number of

leaflets. The leaflets in all but *C. bulberifera* are like long and narrow willow leaves, but sharply toothed. Its leaves are like blades of grass, sharply but sparingly toothed. In all species but *C. bulberifera* and *C. californica*, the veins run to the notches between the teeth and not to the points as they do in all other members of the parsley or carrot family. A very close examination will show that these veins do not actually reach the notches, but they always appear to do so, and this is diagnostic.

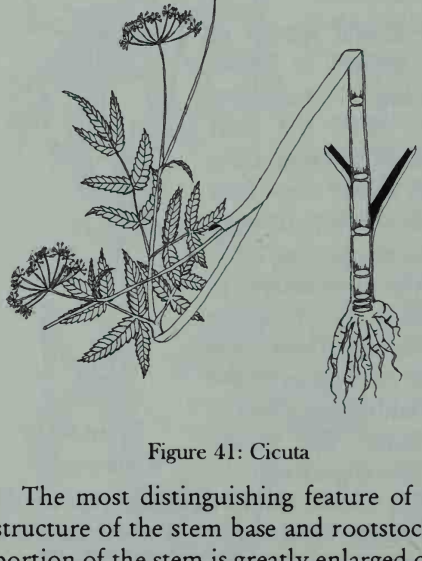

Figure 41: Cicuta

The most distinguishing feature of *Cicuta* is the unique structure of the stem base and rootstock. This underground portion of the stem is greatly enlarged or thickened, and this area contains a number of short air chambers separated by transverse partitions. Very young plants may not have actual chambers, but the future structure will be represented by yellow layers embedded in a white matrix. Cut surfaces of this stem base yield a yellowish exudate that is strongly parsnip-scented. This sap will cause a severe and painful dermatitis on contact with the skin, so wash thoroughly after handling.

The roots number from one to several, and are shaped much like sweet potato or dahlia tubers. They are tender in texture, of good size, smell good (if you like parsnip!), and apparently taste good. They cause numerous human deaths and are one of the worst livestock poisoners. (See Figure 41.)

The best protection until you have learned to recognize members of this genus is simply to avoid use of any member of the carrot family that grows in wet situations unless it has features that clearly distinguish it from *Cicuta.* The cow parsnip, for example, has hairy or woolly stems and large, maplelike leaflets, and many species of *Angelica* have large leaflets that could not possibly be confused with those of the water hemlock. These are the only edible genera listed that grow in such wet areas.

Only Cicuta *has a chambered stem base and rootstock that contains yellow, parsnip-scented sap; smooth, powdered, red or purple splotched stems; dahlia- or sweet potato-like tubers; and veins that run to the notches of the leaflets. No other plant has these features. Be certain of identity or do not use!* There are many other sources of food, but you have only one life!

Wild celery is the domestic plant escaped from cultivation and is now sparingly established to moderate altitudes in some areas. It looks, smells, and tastes exactly as does the commercial plant, but is usually smaller and somewhat less juicy. It is more widely known for the crisp leaf stalks than for its roots, but these are a splendid flavoring agent for soups and stews and can also be eaten as a vegetable if sliced thinly and cooked in two or more waters to reduce the flavor.

The various species of *Angelica* are also known as wild celery, and the stalks are used as celery substitutes. These are tall plants (though one coastal species sprawls) with compound leaves, the leaflets being oblong, egg-shaped, or

nearly round, variously toothed, and strongly aromatic. The stems are smooth and hairless to near their tips in most species (one coastal species has hairy stems), but the topmost part of the stems and the flower heads are thinly hairy to strongly woolly. The flowers are white, in rather large heads. Found from seashore to rather high altitudes, these plants offer and excellent survival food during the summer months. *Be careful at first!* You may be allergic to these; many are.

CAUTION: Some species share habitats with the water hemlock, *Cicuta,* or the poison hemlock, *Conium. The veins of the leaflets in Angelica lead directly and obviously to the points of the teeth; the stem is neither marked with red or purple nor powdered; the stem base is not chambered or filled with oily, yellow, parsnip-scented sap; the leaves are not elliptical; and the roots are not clustered tubers. Be certain of identity or do not use!*

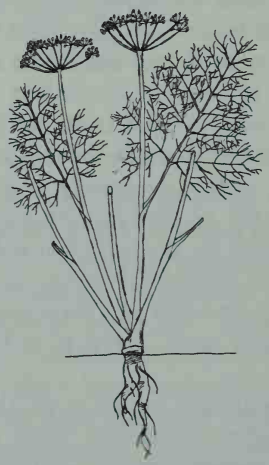

Figure 42: Sweet fennel

Sweet fennel, also known as wild anise or wild licorice, is a densely clustered plant to six feet tall, the individual stems meaty and juicy, almost solid (with a very tiny hollow), bluish-green, densely powdered, very strongly licorice-scented and flavored. The leaves are compound, with numerous threadlike leaflets. The flowers are yellow, in large heads. The odor and taste of licorice is too strong for use as food unless boiled in several changes of water, but the leaves, stems,

roots, and seeds are splendid for seasoning other foods. The stems make a pleasant nibble, and a few chopped stems added sparingly to salads will improve flavor. This plant has escaped cultivation to become well established in scattered colonies, and it is now widespread. (See Figure 42.)

Sweet Cicely is a genus of several species, the stems slender to stout, erect, and thinly or not at all hairy. The leaves are compound, the leaflets shaped like short blades of grass or egg-shaped, variously but sparingly toothed, in some species sometimes cut or lobed; all are licorice scented. The primary rays are very long, and the compound umbel is not at all headlike. The flowers are white, sometimes with a greenish or purplish tinge. The seeds are very sharp and bristly, clinging to the clothing and hitching a ride to new locations. One or another of the species may be found from sea level to high altitudes in almost any nondesert area of the continent. Both the roots and the foliage are edible either raw or cooked, but you may find it necessary to cook in two waters to tone down the licorice taste.

Remember! With any member of the parsley family, take special pains to identify before using. *Be positive of identity or do not use!*

Among the many plants with both edible foliage and roots are members of the chicory or dandelion tribe of the Composite family. This group is characterized by certain distinctive features held in common and distinguishing them from other members of the family. Among these features are the typical shape of leaves, the flat "petals" of the flowers, and the bitter, milky latex that exudes when part of the foliage is cut or torn. No member of this group is harmful in normal amounts, but many are so distasteful that you would find it hard to eat them.

Remember that other plants may have leaves shaped somewhat like those of this group, and others may have

bitter milky juice (this often indicates poisonous qualities in other families!) or dandelion-like flowers. No plant not a member of this group will have all three of these features, and you can safely assume that any plant that has all three is edible. Don't be deterred by initial bitterness, as both dandelion and common lettuce become excessively bitter with age.

The common dandelion has hollow, thin-walled, leafless flower stems to a foot or so tall, rising from a basal rosette of green leaves that are raggedly cut all the way to the midrib. The flower (actually a large number of ray flowers forming a ligulate head) is bright yellow, and is familiar to all. There are many subspecies and varieties, each of which very closely resembles the others. The leaves, flowers, roots, and stems are edible; and large populations have subsisted almost exclusively on dandelions in time of famine. Boil older plants or roots of any age in two or more waters to reduce bitterness. Dry the roots and slowly roast them until they are brown and crumbly, then pulverize and use as a coffee substitute.

False dandelion resembles dandelion very closely and is even more of a pest, as it has a much longer blooming period. It has smaller heads than the dandelion, and its somewhat taller stems are solid and strongly ribbed. It is both edible and rather good, lacking the bitterness of dandelion.

Wild lettuce is a common and troublesome weed, often protruding from cracks in city sidewalks and completely filling roadside ditches or dominating uncultivated areas. The leafy stems are as much as twelve feet tall in the various species and are smooth and hairless in all but one that has a bristly base. The leaves are short-stemmed or stemless, then tending to clasp the main stem, very long and oblong in shape, cut or lobed, often armed with weak and nearly transparent prickles along the thin edges. The flowers are bright yellow, pale yellow, or pale blue, not more than an inch in diameter, in open, terminal clusters.

These plants are cousins of garden lettuce, and like it they become excessively bitter with age. This quality can be subdued but not eliminated by cooking in two waters. The juice of these plants was formerly collected, coagulated, and used as an opium substitute, but seems to have achieved its effect through the power of suggestion rather than from any intrinsic property. Eaten in large quantity, however, these plants do seem to have a mild tranquilizing effect on some people.

The sow thistles are rank-growing, bushy weeds of widespread distribution. The entire plant is weak-prickly, but the foliage and the flowers are so similar to those of the dandelion that they are instantly recognized as being closely related. The foliage and the roots are edible, but again should be cooked in two waters to improve the taste.

Chicory roots are famous as a coffee substitute or adulterant, and the leaves are widely used in salads. (Endive is a cultivated variety.) The large cluster of basal leaves is blue-green, otherwise much like dandelion leaves. The densely clustered, stiff, much-branched stems have many small, clasping, stemless leaves. The flowers are to two inches wide, a beautiful shade of blue, nearly or quite stemless, and numerous. The stiff, leafless, clustered stems are distinctive even in winter, and will enable you to locate the still edible roots. Dry these roots and roast them until brown and crumbly, then pulverize and use as a coffee substitute. The roots can also be eaten as a vegetable. With either roots or leaves, it is necessary to cook in two or more waters to reduce bitterness.

The oyster plant or the similar goatsbeards have leafy stems to two feet or more tall. The leaves are bluish-green, clasping, long and narrow, tapering regularly, differing from those of other members of their group by being smooth

edged and uncut. The purple or bright yellow flowers are cupped in a saucer-shaped involucre (a group of pointed, tapering, modified leaves), the tips of which extend beyond the bloom. The distinctive puffball is at least twice as big as in the dandelion and is "tattletale gray" rather than white. The roots are carrot-form, of good size. The roots of the purple-flowered species are sold in grocery stores as "salsify." They are said to taste like oysters, but they do not taste so to me. In any case, these roots are edible as cooked vegetables and the foliage is edible as cooked greens. Found from sea level to moderately high altitudes and readily identified, these are a valuable source of emergency food.

Other members of this clan abound, but all can be identified by the shared characteristics of notched "petals," milky sap, and dandelion-like leaves. (The sole exception for oyster plant and goatsbeard leaves has already been noted.)

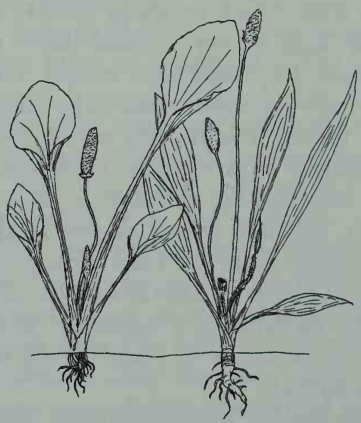

Figure 43: Plantains

Another widespread and ubiquitous genus of edible plants is plantain. Most of these plants have long, narrowly elliptical leaves, but two common species have roundish leaves, all in basal rosettes, with indented, parallel veins. The flower stems are slender, leafless, often minutely hairy or fuzzy, usually strictly erect but occasionally nodding (bent over at the tip), bearing a very dense spike of inconspicuous flowers. The leaves make

excellent greens, but should be chopped into short lengths to eliminate stringiness. One coastal species has thickened leaves that snap almost as crisply as green beans and need to be destringed. Bland and tasteless in some species, rather tasty in others, these plants furnish an abundant and easily identified source of food for most of the year. (See Figure 43.)

Another very valuable source of camp or emergency food is the beet family. Its members are among the most salt-tolerant plants known, and can be found in saline or alkaline areas where little else will grow. All but a very few are edible, and most are good. The inedible ones are uneatable because of odor or taste, not because of toxicity.

White pigweed, also known as lamb's quarter, goosefoot, and wild beet, is a common and widespread weed, growing mostly in disturbed soils. It grows to four feet or so tall, is many branched, and has roughly triangular leaves with stepped sides that more or less resemble a goose's foot. All of the foliage, but especially those leaves near the tips, are covered with a white (or sometimes pinkish) mealy powder that gives the plant a grayish-white appearance. The seeds appear in dense spikelets in the axils (leaf-stem junctions) and in ball-like clusters at the stem and branch tips. These seeds remain on the dead plant till midwinter, are highly nutritious, and can be gathered in good quantity. Grind them for flour, cook as mush, or add to soups and stews. The leaves and tender young stems are widely used as cooked greens, and in my opinion are far superior to chard or spinach. My children all shared this opinion. They disliked spinach and tolerated chard, but loved pigweed.

More than a dozen other species of this genus are listed, and one or another may be found anywhere, as they range from coast to coast and from sea level to moderate altitudes. All but one are edible, and most are very good. One

Northern species, known as "Indian strawberry," has pulpy red seed clusters that can be eaten out of hand like a fruit. They are not at all distasteful, but neither are they very good, at least to me. All of the species resemble each other very strongly and are easily identified. You will know the bad one by its strong chemical odor.

Hop sage is a low-growing bushy shrub with brown or grayish, shreddy bark on more or less spiny stems. The leaves are pale green, scaly or mealy, egg-shaped but largest at the outer end, to one and a half inches long. The flowers are inconspicuous, generally unisexual (male or female only on a single plant), but sometimes with both on the same plant, in terminal spikes. The developing seeds are encased in an open-mouthed pouch formed by the fusion of two fleshy red or pink bracts, and the female plants become somewhat showy when in fruit. The leaves, seeds, bracts, and the tender young twigs are all edible when boiled as greens. The plants grow in slightly salty or alkaline soils and from low desert areas to moderate altitudes.

Winterfat is a semisprawling shrub that is densely covered with woolly white hair, and this gives the bushes a distinctive whitish appearance. The leaves are long-oval, to two inches long, with the long edges rolled tightly inward. The flowers are inconspicuous and the seeds appear to be balls of cotton in the axils (leaf-stem junctions). The plants then appear to be completely filled with cotton. They grow in salty or alkaline soils, mostly in the sagebrush communities of the West. The leaves and the tender twigs are edible when boiled.

Greasewood is a tall, bushy shrub with whitish bark and with most of the twigs ending in sharp, hardened spines. The leaves are dark green, to an inch and a half long, fleshy, and triangular to almost round in cross section. The male or staminate flowers look much like small fir cones at the twig

tips, and the separate, inconspicuous female flowers are almost hidden in the axils. These shrubs grow in dense colonies on strongly salty or alkaline soils in the arid areas of the West. The leaves, the tender young twigs, and the staminate "cones" are all edible when boiled, but they must not be eaten in large quantity unless boiled in two waters to remove excessive salt and acid concentrations.

Orach or saltbush species form a large group of annual and perennial plants, some of which are even shrubby in character. The foliage is usually mealy or scaly, the stems are often strongly angled, and the outline of the plant is usually rounded or pyramidal, although two species are sprawlers. The foliage bears a marked resemblance to that of the goosefoots, and the plants are readily recognized, regardless of species. The various species are found in alkaline inland areas and in saline soils along the immediate coast, and they are common in almost the entire continent to moderate altitudes. One species is commonly cultivated as a vegetable garden favorite, and the others are just as edible. Cook the leaves and the tender stems as greens, boiling in two waters if necessary to eliminate saltiness.

Russian thistle is a much-branched annual weed, the branches mostly from the base, growing outward at first, then curving upward and inward to form a ball-shaped or globular mass. The main stem and its branches are sharply ridged. The lower leaves and some of the leaves on the primary branches are long and narrow, to nearly three inches long. The leaves on the smaller twigs are very similar but shorter and end in sharp spines. This is a notorious member of the "tumbleweeds" and a pernicious pest. Even so, the younger plants (before the thorns form) are very good when boiled as greens, and such plants will develop from earliest spring to late fall, springing up after every rain. The plant is salt-tolerant but will grow in other soils, and it is far too

common and widespread in the drier areas of the West to moderate altitudes.

The several species of blite (*Suaeda*) are succulent weeds that are sprawling or only weakly erect, with fleshy leaves that are often nearly round in cross section, these ending in sharp but not hardened points. They grow only in salty or alkaline soils of the western states, but reach fairly high altitudes. The leaves are edible when boiled in two waters, and can be eaten raw when mixed with other and less salty foods.

Glasswort or chicken claws is an erect or sprawling plant with round, lead-colored internode sections shaped like baseball bats and with the vestigial leaves forming complete disks at the nodes. A reddish species occurs. It is found in salt marshes along the coast but occasionally grows in salty or alkaline marshes inland. Wherever found, the entire plant is edible either raw or cooked. It is extremely salty and may be used to add salt to other foods.

Five-hook bassia is a much-branched annual weed to three feet or more tall. The stems are finely hairy throughout, and this hair becomes white and woolly near the stem and branch tips. The leaves are largest at the tip, pointed-oval, to nearly an inch long, smooth edged, and covered with fine, silky hair. The single flowers grow in the axils, and each of the five sepals is equipped with a long and sharply hooked spine. This is a widespread plant in the drier areas of the West and is a valuable forage plant, especially after the nutritious seeds develop. The whole plant is both edible and good. Boil the foliage as greens and grind the seeds to use as flour or cook them as mush.

Patata is one of several species of *Monolepis* that are edible. Its much-branched stems are sprawling or weakly erect, succulent, smooth and hairless, with lance-shaped leaves that have a pair of wide-spreading lobes at the base. The inconspicuous flowers are in dense clusters in the axils (leaf-stem

junctions). These plants grow in damp salty or alkaline soils throughout the drier parts of the western states. The entire above-ground plant is edible when boiled for greens. The other species are very similar to patata and are just as edible.

The purslane family produces a rather large number of edible species. These are succulent and fleshy herbs of various habit and are widely distributed.

Purslane or pussley is a sprawling plant, much-branched from the root crown, with reddish, smooth, and very fleshy stems. It has almost or quite stemless green leaves to three quarters of an inch long, long-oval but widest at the tip, and thick and fleshy. The flowers are tiny and bright yellow, in clusters at the stem tips. The seeds form in urn-shaped capsules with hinged lids. It is common and very widespread in the Southwest, and occasional in the Northwest, mostly in disturbed soils. This is a weed of worldwide distribution, originally from Europe, where it has been used for food since ancient times. Cook as greens, using no water other than the drops that cling after washing, fry in fat, or eat raw as in salads or out of hand. You will find it both nourishing and very tasty.

Spring beauties are widely admired for their flowers, but they are also appreciated for the flavor of their edible roots. The several species are perennial herbs with fleshy bulbs or almost carrot-form roots, with many long-stemmed basal leaves and usually only one pair of leaves on the erect flower stem. The leaves vary from diamond, to spoon, to lance-shaped. The flowers are shaped like saucers or like shallow bells, with whitish to pure pink petals veined with darker pink to rose-red, in an elongate cluster at the stem tip. The plants are common and extremely abundant in the sagebrush areas, usually in the wake of melting snow, but are also available in wooded areas and in wet scree or talus to very high altitudes. The roots can be eaten either raw or cooked, but

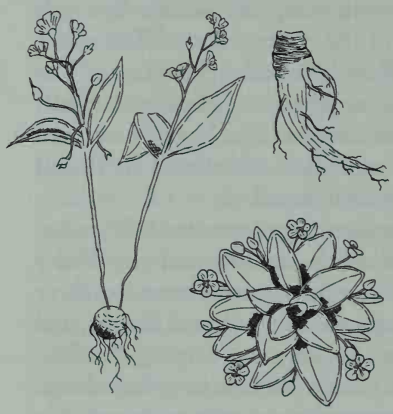

Figure 44: Fairy spuds

are at their best when cooked as with potatoes. Indeed, they are often known as "fairy spuds." The foliage is also good either cooked or raw. (See Figure 44.)

Miner's lettuce is the name normally given to one species of *Montia.* This plant is very distinctive, with numerous slender but succulent stems rising from a basal cluster of leaves that vary from diamond- to spoon-shaped, with each of these itself having a slender stem almost as long as the flower stems. An interesting feature of the flower stems is a separable threadlike core. Each flower stem grows through the middle of a bowl or cone-shaped leaf (actually two fused leaves) just below the flowers, which are white or pinkish. The other species of this genus are very similar, but have a pair of leaves instead of the fused, bowl-shaped leaf on the flower stem. They occur from the

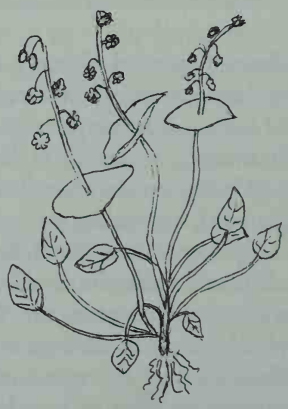

Figure 45: Miners' lettuce

sagebrush areas of the western deserts (in moist spots only) to the forests of the Pacific slope. They tend to be small and often reddish in areas of little moisture and low fertility, but grow very lushly and are a rich, vivid green in moist and fertile soils. In many forested parts of the Pacific Northwest, these plants form extensive ground covers. They are delightful in salads, good as boiled greens, and rather tasty when eaten out of hand. (See Figure 45.)

Bitterroot is one of the plants that formed dietary staples for some western Indians. This plant has short, fleshy, almost cylindrical leaves that wither before blooming time. The flower stems are so short that the spectacular, cactus-like, white or pink flowers appear to be lying on the sand or rocks, like a dropped bouquet. These flowers close tightly at night, to reopen only when the day has warmed, and barren hillsides will suddenly be transformed into a flower garden when the blooms open. This is an arid-country plant, occurring from the high sagebrush country to sterile mountain slopes and ridges over much of the West. The fleshy, branched roots are edible, nourishing, and even almost tasty when peeled and boiled, but the skin is intensely bitter. Common and usually abundant where found, this is both a very beautiful wildflower and a useful source of emergency food.

The mustard family produces a tremendous number of edible plants in a large number of different genera, but only a few of the more valuable food plants will be mentioned here. All of the plants are characterized by, and they are named for, the cruciform (cross-shaped), four-petaled flowers. The seeds form in podlike capsules, these of wildly varied shape. All the members of this family are edible in the sense that none are toxic in small amounts, but most should not be eaten in large quantities because of the irritant mustard oils that give the family its distinctive taste.

Spoonwort is a sprawling or weakly erect, many-branched plant with kidney-shaped or spoon-shaped dark green leaves that are very coarsely or not at all toothed, often with both types on the same plant. They are long-stemmed near the main stem base, but become short-stemmed or completely stemless near the tips. The plants occur only along the immediate coastline from northern Oregon to the Aleutian Islands. You can eat the leaves raw, but they really shine as cooked greens.

Mustard is a broad common name that covers several genera. Most of the plants are tall, weedy, annual herbs with distinctively shaped divided or deeply cut leaves and bright-yellow flowers in terminal clusters. Whole fields are often painted by the profusion of mustard plants. The seeds are borne in slender, usually curved, pods. Common and very widespread, occurring almost throughout the continent, these are a valuable food resource. The plants make delightful greens when young and tender, and the roots are pungent but good either raw or cooked. Radishes, turnips, and rutabagas, as well as the many forms of cabbage, are members of this clan. The flower buds or the flowers themselves are very similar to broccoli when boiled until just tender, and the seeds can be ground to make the familiar condiment or used to season other foods. The hot or pungent taste of mustard plants is produced by highly irritant mustard oil, and either the seeds or the older foliage can cause intestinal irritation if eaten in too large an amount.

Watercress is one member of the mustard family that was deliberately imported from Europe, where it has been used for food throughout history. Indeed, some of the ancient Greek and Roman writers wrote effusively of its virtue both as food and curative herb. The plant grows in shallow water, has typically mustard-shaped leaves, and the floating or submersed stems are festooned with white threadlike roots. The

flowers are white. The typical mustard taste is present but subdued, and the raw plants are very pleasant tasting when eaten out of hand or in sandwiches or salads. *Do not use them raw if the area is or may be polluted!* They are also a splendid additive to blander greens and are good when cooked alone.

The toothworts or crinkleroots are low-growing herbs with lobed or compound leaves from the base, these sometimes springing up at a distance from the main stem, and usually with much smaller parted or lobed leaves on the stem. The roots of these plants vary from fleshy rootstocks to actual tubers, and these are very tasty when eaten raw. Many people regularly seek these plants to use the roots as a very mild substitute for horseradish. The plants are very common and widespread, mostly in woods or thin timber. The flowers are sometimes locally known as spring beauties.

Shepherd's purse is a common weed known primarily for its persistence in lawns. It has a basal rosette of oblong leaves that are wavy edged and thinly hairy, and a few smaller leaves on the slender, branching flower stem. The flowers are tiny, inconspicuous, on rather long pedicels in an elongate terminal raceme. The single most interesting feature, and the most positive means of identifying the plant, is the unique shape of the seed pods. These look exactly like little green valentines that are attached by their small ends to the threadlike pedicels. These pods are easily stripped by the handful and have a pleasantly tangy "zip" when eaten raw. The leaves are excellent as greens, and it is said that Boy Scouts prefer this plant to all others for their camp cooking.

Knotweed is a very large family of plants that furnishes edible species in several genera. One or another of these species can be found in almost any area of North America not covered in snow or ice.

Wild buckwheat is a large genus with plants generally found in areas of low rainfall, and is especially well represented in sagebrush communities. The various species are annual or perennial, generally with clusters of thinly to densely woolly leaves of various shapes in basal clumps, and with many naked flower stems, these forking again and again into two or three equal branches. The flowers are various shades of yellow, orange, red, or white, heavily scented, generally in ball-shaped compound heads cupped in brightly-colored saucers (involucres) of modified leaves or bracts, but sometimes in branching, terminal clusters. The flowers of several species dry to a paperlike texture, and the dried heads then remain showy into early winter. All of the species are edible in all their parts, but only the basal leaves are available in sufficient quantity to be useful as emergency food. Boil these leaves in two or more changes of water to reduce the overly strong taste.

The docks are abundant and widespread weeds that are easily recognized by the dark green leaves and the panicles of dark brown, reddish-brown, or rose-colored three-winged seeds. There are a number of species, several of which densely cover dried creekbeds or pond bottoms in otherwise arid country. The leaves of all species are edible in small amount, and some taste good as well. *Don't eat in large quantity unless you change cooking water at least once!* The "lemony" taste of these plants is imparted by soluble oxalic acid, and this is toxic if substantial amounts are eaten without proper preparation. The seeds are edible either when ground as meal or when cooked as mush, and it is not necessary to change water unless to eliminate strong taste. Rub the three-winged seed hulls briskly between the palms to free the seeds, letting the wind blow the husk fragments away. If there is no wind, use a fan or your breath.

Sheep sorrel is a dainty form of dock, varying drastically in size with growth conditions. In lawns or other moist and

fertile spots it is a cushion-shaped mound of halberd-shaped leaves of vivid green, eventually developing a cluster of slender stems decked out with enormous numbers of small reddish seeds. In areas of low fertility or dry soils, the plants show as small clumps of pale green leaves connected by long, underground runners. It has been said that no French chef could possibly cook without sheep sorrel. Whether or not this is so, the plant is indeed a delicious component of salads or a pot of mixed greens and adds a delightful flavor to gravies or sauces, soups or stews. It can also be eaten out of hand, but sparingly. The piquant taste is imparted by soluble oxalic acid, and this is toxic if ingested in considerable amounts. When cooked in two waters, the acid is largely dissolved and poured out with the first water; and the plant is then perfectly safe to eat in any normal amount. (See Figure 46.)

Figure 46: Sheep sorrel

Mountain sorrel is a smallish alpine plant with heart- or kidney-shaped leaves that are deeply indented at the point of attachment to the long petioles (leaf stems). The seed hulls are flattened, round or nearly so, rose-red, each on a different threadlike stem. These plants are found at high altitudes nearly throughout the continent, and in such profusion that mountain slopes are colored by the seeds as if by red paint. This plant, too, contains rather high levels of soluble oxalic acid and can be dangerous if eaten raw in large amounts. It is very tasty, however, even after being boiled in two waters, and is a highly valuable food source both because of the ease of identification and its choice of

habitat. You can safely eat a sprig or two raw, but don't overdo it!

Wood sorrel or wild shamrock is an annual herbaceous plant. Various species grow in damp, wooded, or forested areas nearly throughout the continent. The three-lobed leaves look exactly like those of the shamrock or like a monstrous three-leaf clover, with each leaf creased or folded in the middle. The leaves close at night and reopen with the return of day. They are tasty when eaten out of hand, in sandwiches, or in salads, but they contain too much soluble oxalic acid to be eaten in quantity unless boiled in two waters.

The soluble oxalic acid (salt of lemon) that makes these plants so tasty also makes them dangerous. The acid is dangerous because of its solubility and its affinity for calcium. The solubility permits the acid to enter the bloodstream, where it combines with calcium to form nonsoluble calcium oxalate. This precipitates out in the kidneys, where it both plugs the tubules and burns and kills all cells in contact with it. This causes renal failure and death. The acid readily dissolves in heated water and it will combine with calcium as readily in that water as in the bloodstream. Adding bone fragments, egg shells, or other sources of calcium to cooking water will transform the oxalic acid to nonsoluble calcium oxalate in the kettle, retaining the full flavor, but the acid is then no longer dangerous. If you have no such materials, simply pour out the first water after boiling for a time and replace with fresh water. These plants are excellent food when properly used, but they are potentially deadly if misused.

Amaranth is a genus that produces both edible and palatable products. Redroot pigweed grows from low to moderately high altitudes almost throughout North America. It grows to six feet or so tall in favorable locations or when started in spring; but it grows, matures, and even produces

viable seed from a total height of three or four inches in unfavorable locations or when springing up from seed after late summer or early fall rains. It has erect, robust, slightly hairy stems that are often streaked with red, and the carrot-form root is distinctly reddish. The roughly triangular leaves are to eight inches long. The countless seeds are held in fuzzy to bristly spikes at stem and branch tips. The plants normally grow in dense colonies and can be obtained in good quantity where found. All parts of the plant can be eaten, but the seed husks should not be eaten raw because of their abrasive harshness. (See Figure 47.)

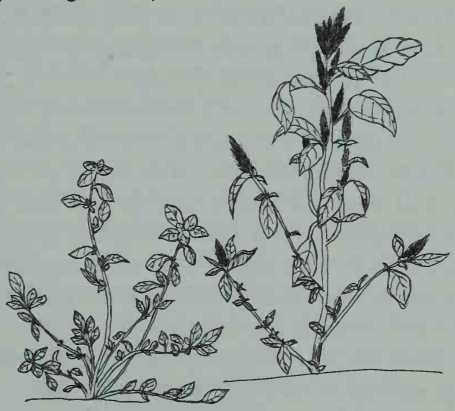

Figure 47: Amaranths

Tumbling amaranth is found in semidesert areas to moderate altitudes. The branches grow outward at first, then curve upward an inward to form a spherical shape, and the plant is one of the more common tumbleweeds. The leaves are pale green, more or less egg-shaped, not more than an inch and a half long. The younger plants are edible as cooked greens, and the seeds can be used as flour or mush. (See Figure 47.)

Sprawling or prostrate amaranth is similar in foliage and in food value. (See Figure 47.)

The grass family is one of the largest plant families, containing literally hundreds of genera and thousands of species, ranging from tiny annual plants to giant bamboo. All are characterized by jointed culms (stems), these usually but not always hollow, and by alternate, parallel-veined leaves, these long, narrow, and tapering more or less regularly to a point. These leaves normally sheath the stem at their bases, and most have a semitransparent membranous structure (a ligule) above the sheath-leaf junction. The flowers are inconspicuous (they are wind pollinated) in spikes, racemes, or panicles. The seeds or fruits are grains, differing mainly in size, color, shape, and flavor among the species.

The stems, leaves, and seeds are edible in all species, but one must be alert to the danger of mechanical injury from harsh, sharp bristles or saw-edged leaves in some species. Boiling will eliminate the hazard in the case of leaves or stems, and threshing and winnowing will get rid of bristly seed husks. One must also beware of either smut or ergot. Both appear as shapeless, moldlike masses on the seeds, black for smut and purplish for ergot.

The most efficient way of gathering grass seeds is to cut the grass and lay it on a blanket or other seed catcher, then beat it with a flail or a limby switch to knock the seeds off the spikelets. Another method is to weave a shallow, basket-shaped swatter out of limber switches of wood, then use this to knock the seeds off standing grasses into a waiting container. With many species, it is practical to bend the grass over until its seed-bearing tops are within or just over a container, then strike the tops a sharp blow with a stick to free the seeds. *These methods will work only if the seeds are ripe!* A more primitive method, and the only way with unripe seeds, is to strip the seeds by hand.

Once harvested, you must thresh and winnow the seeds to separate the edible grain from the inedible (or unwanted) chaff. Threshing is best accomplished by beating with a stick or flail, but it can be done by rubbing with a stone, or even by rolling between the palms. The chaff can then be removed by pouring the grain from a considerable height when a brisk breeze is blowing, by blowing the chaff out of a handful at a time with your breath, or by dumping both chaff and grain into a container of water. The lighter chaff will float high and dry, while the heavier grain will either sink or at least float less buoyantly. With those species having bristly husks that are difficult to separate, it is useful to thoroughly singe the husks before threshing.

Parch the threshed and winnowed grain to be eaten out of hand, grind it for use as flour by rubbing between stones, or cook it as mush. The seeds of many species are also very good when cooked with meat or in soup or stew. The boiled stems and leaves of grasses are also edible.

Various species of grass occur from ocean edge to well above timberline, and from semidesert to marshland. Indeed, these plants cover many thousands of square miles of the planet to the near exclusion of other plants. While man is not a grazing animal, there is no reason for anyone to starve while grasses are available in readily usable form.

Other edible plants abound, but a more comprehensive listing would serve no useful purpose. Those listed provide a sufficient selection of plant foods for any area and for any time of year. It is hoped that some readers will come to enjoy identifying and sampling or using some of them in the absence of need.

Chapter XX

Winter Problems

Winter presents many special problems whether or not one is lost or stranded. One of the worst hazards is the danger posed by snow-covered ice that often disguises shallow ponds or overflow areas as solid ground. Once the ice is blanketed with snow, it is insulated against the cold and will often remain much too thin to support a person's weight.

A heavy snowfall or drifting snow will often cover a stream, even when the stream is only thinly covered with ice. The stream will then erode the ice, chunks of snow will fall from the underside of the snow blanket, and the result will be a hidden snow tunnel. The roof of such a tunnel will not bear much weight and will cave in if you venture onto it, dropping you for an unknown distance and into water of unknown depth. A similar situation exists where the water level has subsided, leaving a sheet of ice suspended well above the water. Such spots are death traps for the unwary.

You can often hear the gurgling of a hidden stream, but you must not count on being able to do so; for snow is an efficient sound insulator. A pond or overflow makes no sound, of course; and your ears cannot help you detect its presence. Your eyes, too, are only partially effective in locating such dangers.

At the bottom of a canyon, you can safely assume that some sort of stream or at least a stream channel exists, and you can usually tell where the low point of the canyon floor is. In flat country, although a stream's channel may not be

visible because of heavy or drifting snow, there are usually visible indicators of its presence. Streamside thickets will project above shallow snow, or will show up as parallel mounds even when completely buried. Streams in such country tend to meander, and those sections running in the direction of the prevailing wind will show up as depressions even when those sections at nearly right angles to the wind are drifted completely full. The channel will thus show up as an interrupted or disjointed series of depressions in the snow when seen from a distance.

Ponds and overflow areas usually appear as perfectly flat areas, but this is not always the case. Cattails, reeds, bulrushes, or other aquatic vegetation that projects above the ice catches and holds falling or drifting snow to create mounds or hummocks, and many overflow areas are choked with weeds and brush that grew before the flooding occurred. Drifting snow often creates shallow ripples even on level surfaces, too, and these will trap larger drifts once they have compacted.

Unless you are so thoroughly familiar with an area that you know beyond doubt that no ponds or overflows exist there, or know exactly where they are if they do, you should carry a pole and use it to probe suspicious spots before trusting your weight to them. The pole should be slender but fairly heavy, sharply pointed at the small end, and free of knots or other projections that would make it hard to jab through considerable thicknesses of snow.

Another hazard is crossing small streams when ice and snow obscure the dividing line between land and water, or when everything is slick with ice. If you must cross the stream, use extra caution in doing so. Do not attempt to cross by stepping from rock to rock unless these are so close together that you can easily step from one to another without stretching, jumping, or risking your balance, unless they

are free of ice, and unless they are so solidly planted there is no danger of them moving under your feet. Use a staff of some kind as a prop or brace. Do not attempt to cross on a log unless it is large enough not to spring under your weight, solid enough to bear that weight without danger of breaking, and not slippery or covered with loose bark or rotted wood that could peel off under your foot. If the log is not large enough to offer secure footing but is otherwise suitable, straddle it and inch your way across.

It is possible to pole vault over a stream if it is not too wide. Ten to twelve feet would be the normal maximum. If at all possible, select a spot where you can vault from a higher to a lower bank. *The landing spot must be free of obstacles that could injure you!* The pole used in vaulting must be sturdy enough to avoid even the possibility of breaking, and it must be long enough to reach from the center of the stream to your bank plus your own height. To use it, plant the large end firmly in the center of the stream, working it about to make sure it is not resting on a loose or slippery rock or in soft sand or silt. Grasp the pole near its upper end and vault the stream. If you have not pole vaulted before, or if you are unsure of you ability to do so, practice on dry land before tackling the stream. This will increase both your proficiency and your confidence.

The less weight you carry, the easier it will be to vault. Use a long pole or two poles lashed together to transfer your extra gear (gun, pack, sleeping bag, snowshoes, etc.) to the far bank. It is even possible to build a fire there by transferring blazing material from a fire built on the takeoff bank. This is good insurance if weather conditions are such that an accidental wetting would be extremely dangerous, as it will eliminate the need to start a fire from scratch after you have been wetted. *Remember! Once you have transferred your gear, you cannot then change your mind about crossing!*

If none of these crossing systems is practical, you can wade the stream. Follow the stream until you find a shallow spot with a firm bottom and low banks. (A high, steep bank normally indicates deep water at its base.) Retreat to the closest narrow spot (regardless of depth there) and cut a pole long enough to reach across the stream with room to spare. Use it to transfer your gear and to build a fire on the far bank. Return to the shallow spot. Take off your boots and socks and roll up your pantlegs. If the water at your crossing spot is so deep that the trousers will surely become wet, take them off and throw them to the far bank. Put your boots on without socks to protect your feet. Wade the stream as quickly as possible without taking unnecessary risk, using the pole to probe for deep spots, to brace yourself against the current, to preserve your balance, and to break away thin ice in your pathway.

Once out of the water, go quickly to your pile of gear and prekindled fire. Towel yourself dry, even if you must use part of your clothing as a towel. Put on dry trousers and dry socks. If you are wearing rubber boots, simply wipe them dry inside and put them on again. You have then only to dry the material used as a towel and boot-wiping cloth and you are ready to proceed.

If you are wearing rubber boots with a fleece lining (and you should not be!) or leather boots or shoes, then you must either thoroughly dry them or use plastic or other thin, waterproof material to wrap your feet so you can wear them wet. *You must not attempt to dry leather boots or shoes by direct heat!* Too much heat will crack, deform, and harden wet leather to make the footgear unusable. Instead, wipe the boots free of excess water and stuff them full of heated absorbent material such as cloth, dry grasses, crumbled dead leaves, dry conifer needles, or well-dried moss. When this material has absorbed all the water it will hold, remove and

replace it with fresh material or dry it for reuse. Repeat the process as often as necessary.

To use wet boots without drying them, wrap the bare feet with plastic film or a space blanket, put on one or more pairs of dry socks, then cover with another waterproof layer. If you lack material to make two layers, forgo the inner one. Moisture from the saturated boots cannot invade the socks to rob them of insulative capacity, and your feet will remain warm even if the boots freeze. If frozen boots begin to chafe and injure your feet, stop, make camp, and dry them. *Don't let them blister your feet!*

If much of your clothing has been soaked, there will probably be several different materials involved, and each of these presents unique drying problems of its own. Cotton fabrics may be dried rather quickly at fairly high temperatures. Anything made out of wool must be dried slowly and at low heat to prevent scorching and shrinking. (The "felt" liners used in some types of ski boots, in rubber overshoes, and in rubber-bottomed, leather-topped shoe pacs are made of wool.) Down is nearly impossible to dry under field conditions. Many of the synthetics will drip dry with no heat at all, and others will melt or evaporate if exposed to high temperatures!

Wind will dry clothing spread over a bush, even in low temperatures; and you can "freeze dry" clothing by allowing it to freeze when exposed to wind. The ice will evaporate (sublime) without thawing.

In many situations, small creeks will have frozen almost or quite to the bottom, and the ice will support your weight. You should test the ice by striking it a hard blow with the end of a heavy pole, just as if you were trying to jab a hole in it. Thick ice on streams or lakes often offers the easiest line of travel, but you must be absolutely sure that the ice is thick enough and solid enough to bear your weight safely.

Even then, you should carry a long pole, holding it by the middle and in a horizontal position. If you were then to break through the ice, the pole would span the hole and keep you from sinking down and under the ice. You can also use it to test any suspicious spot.

The best protection against the very real hazards of winter travel just described is good common sense. Ask yourself if it is really necessary to travel under such conditions or to cross that creek. *If you are lost, and if someone knows pretty much where you are, then the answer should be an emphatic no!* If you are not lost, then the answer would depend on a number of factors.

You should not undertake a really hazardous stream crossing (under conditions of severe cold or high wind all crossings of anything other than tiny streamlets could be so labeled) unless there is a compelling reason to do so. Compelling reasons could be a visible road, cabin, smoke, or even a more suitable shelter site on the opposite bank. Remember, unless you are actually traveling cross country from point A to point B, crossing a stream means you must recross it on your return.

Remember, too, when making such a decision as to how (or whether!) to proceed, that even a trivial accident or injury can be dangerous or life threatening under winter conditions. Remember also that you cannot afford to gamble, as the stakes are too high.

If a major part of your clothing has become wet during stream crossing or mishap, it is unlikely that you can fully dry them before dark, as winter days are short. Don't even try. Stop well before dark to make an overnight camp or shelter and to gather enough wood to last the night. You can turn and otherwise supervise the drying of your clothing as you stoke the fire during the night, and that will be often, believe me! Winter nights are long and cold, and a fire big

enough to keep you warm without adequate bedding or shelter will burn an unbelievable amount of wood, so gather more than enough. If you travel until dark or near dark before stopping, you are sure to have a miserable night of it at best.

You must be alert to the danger of frostbite during winter weather. Ears, nose, cheeks, feet, and wrists are most likely to be affected. *Do not rub a frostbitten area with snow!* Even rubbing with the hands can seriously damage the tissue if done too vigorously. Rubbing with snow would tend to both extend the freezing and abrade and damage the frozen flesh.

Treat frostbite by applying mild heat to the frosted area. Cup an ear or nose in a warm palm, or cover them with a warm cloth. Frosted fingers can be thawed by holding them inside the clothes and clamped in an armpit. Another good method is to sponge the affected area with warmed water. The best way to thaw a frosted or frozen hand or foot is to immerse it in water warmed to body temperature or very slightly higher. (Test the water with your elbow, just as you would with a baby's bathwater.) If water is unavailable or you have no suitable container, use sand or dirt instead. It is also possible to heat rocks (never taken from a streambed or other wet area!) to a moderate temperature and use these as hotpacks around a well-wrapped foot or hand.

Do not attempt to thaw frozen hands or feet by immersing them in alcohol, gasoline, kerosene, antifreeze, or other such liquids! Unbelievable as it may seem, this has actually been attempted! These liquids remain liquid in severe cold because their freezing points are extremely low, and they are as cold as, or colder than, the temperature of the storage environment. To immerse a hand or foot in such liquids at low temperatures is to ensure that the limb will be frozen to the bone and that amputation or worse will result! Besides,

petroleum-based products are toxic when absorbed through the skin!

If you must travel on foot to reach a known destination such as your camp or car, do not thaw frozen feet until you have reached that objective. Frostbitten or frozen flesh becomes very tender and is both painful and easily damaged when thawed; you could not walk any distance on freshly thawed feet without suffering extreme pain and incurring severe damage to your feet. Let the feet remain frozen until you have reached your destination, as long as this is within a few hours. You will not damage the frozen tissue by walking on it, and letting the feet remain frozen for a few hours will cause less damage than trying to walk any great distance on them freshly thawed.

If searchers are looking for you, make a camp and thaw your feet. But even if you choose to settle down and wait for rescue, you should make the camp and lay in a goodly store of wood before starting the thawing process.

When a frozen area begins to thaw, you will experience excruciating pain as feeling returns, and this is both unpleasant and disabling while it lasts. You can alleviate this effect somewhat by sponging the area with cold water or by holding a handful of snow against the flesh for a few seconds. Don't overdo this, as you do not want to retard the thawing process or risk refreezing.

Once thawed, the flesh becomes very sensitive to cold and is easily refrozen. You must be especially careful to prevent this, as refreezing will often lead to loss of the affected tissue or to gangrene.

Another real hazard in the winter is snow blindness. This is a painful irritation of the eyeballs and eyelids caused by sunlight reflected from snow. (Water can cause the same problem, but usually in milder form.) This can manifest itself as anything from a mildly painful irritation to total

blindness. Blindness is temporary, but is no less disabling or incapacitating than permanent blindness while it lasts.

The sun need not be shining brightly to create this condition. Even on overcast days there is enough reflected light to be harmful. If you are forced to squint, your eyes need protection! Polarized sunglasses with close-fitting side shields are best, but regular snow goggles are nearly as good. Ordinary sunglasses will help, but you will either have to shield the sides or darken the skin in those areas, as with charcoal. You can make a domino mask from fabric, bark, leather, or even wood or bone that will furnish the needed protection. The mask must have narrow, horizontal slits to see through. You can also create a makeshift mask by plaiting cattail or other straplike leaves or by simply hanging a bushy evergreen bough or other screening material in front of the eyes. Even painting the sides of the nose and the skin around the eyes with dirt or charcoal will help to some degree. The objective in all cases is to keep light from being reflected from all angles into the eyes.

Treatment of snow blindness when no medicines are available consists of remaining in a darkened area or covering the eyes with a light-excluding bandage of some kind. The length of time required for recovery depends primarily upon the severity of the case, but normally the eyes should not be exposed to really bright light for at least a week. This could amount to a death sentence if alone in severe weather, as you could not do those things that had to be done in order to survive during that time. *If you are forced to squint, take steps to protect your eyes immediately!*

Another problem often overlooked by the uninitiated is the tremendous amount of energy required to wade through soft snow. With as little as eight or ten inches of soft snow, you would expend as much energy in traveling on level land as you would normally use in climbing a moderate hill, and

each added inch imposes an additional burden. In snow sixteen or more inches deep, you could not hope to travel more than two or three miles before reaching a state of total or near total exhaustion. Crusted snow that will almost but not quite support your weight is even worse.

If you must travel in fresh snow or snow with a thin crust, you must improvise a set of snowshoes. These can be made from woven twigs, from strips of cloth or other fabric stretched across a hoop or frame, or even from an evergreen bough. One stranded hunter in southern Oregon walked out on two sections of corrugated roofing salvaged from a burned cabin! He had to tie a long stick to the front end of each "snowshoe" so he could alternately lift them by hand, and he was totally exhausted when he got out, but he did get out!

If you are forced to use evergreen boughs for snowshoes, point the main branch stub to the front and lay the bough with its convex side down. (Practically all conifer boughs grow with a pronounced curve.) Lash a cross stick across a main fork or crotch and weave a stick platform to support your foot. Tie a cord or a stick to the main stub to form a handle that will let you raise the front end as you step. Such makeshift snowshoes will be awkward and exhausting to use, but they will enable you to travel in soft snow that would otherwise prevent all travel. Making do with what's available—that is the name of the game!

Another hazard of winter travel is the danger of being caught in the path of an avalanche or snow slide. Fresh snow is especially subject to sliding when it is deposited in considerable depth upon an earlier and crusted deposit. Most low-level obstructions that would help anchor the snow in place are then buried under the lower layer, which has a smooth and slippery surface. Most avalanches are spontaneous, receiving their starting impetus from gravity alone, with the

slide beginning when the pull of gravity overcomes the holding force of friction. Others, however, are triggered by an outside force. This can be lubrication of the lower surface by melt or rain water; the added weight of a person, an animal, or a falling or rolling rock; snow movement caused by wind; the shock and jar of another avalanche; an earth tremor; or even the sound of a shout, a shot, or a passing plane.

Do not cross open slopes of more than moderate incline or the areas below such slopes unless there is adequate tree cover, and be especially wary where steep side canyons or natural chutes are involved. Snow sliding in such areas is channeled and funneled by the contours to greatly increase both the amount of snow and the speed with which it travels. Such channeled avalanches actually become partially airborne and sweep everything in their path. No trees or other substantial growths are found in regular avalanche tracks, so such growth indicates that avalanches are infrequent or absent there.

If caught in an avalanche or snow slide, mountaineers try to "swim" in the snow, believing that such action tends to keep them at or near the surface. Anyone who has seen the tumbling, leap-frogging face of a snow slide has reason to doubt that this will help, and it seldom works in practice. You should avoid putting the theory to a test by carefully avoiding potential avalanche areas.

One final word on winter and its hazards: Water, whether for drinking, cooking, or other uses, is hard to come by. Ice and snow can be eaten or simply allowed to melt in the mouth, but this severely depletes body heat and is dangerous. Snow and ice can be melted to produce water, but this is a tedious and time-consuming process that requires a great deal of heat. It is usually far easier and simpler to obtain water in liquid form and to heat that water

before drinking. In getting to the water, however, you may be faced with the fact that it lies at the bottom of a precipitous and very slippery bank, or is rimmed by thin ice. In such cases, you should carefully weigh the advantages and disadvantages of the various options and choose the one which promises the best result with the least danger or inconvenience. You must always remember, however, that no amount of simple inconvenience should justify taking a real risk.

Chapter XXI

Making Do

One of the prime essentials in many survival situations is cord, rope, or wire. You should have snare wire and some type of fishline in your emergency kit, but larger cords and ropes are often needed. Since you are not likely to have a rope with you unless you are traveling by car or boat or on horseback, you will have to improvise.

It is impossible to make wire, of course, but you can salvage useful quantities of insulated electrical wiring from a broken-down car or plane. You might blunder onto large steel wire in the form of an abandoned telephone line (when fire lookouts were abandoned or mines worked out, the lines were often left behind) or a disused barbwire fence. Abandoned and collapsed miners' huts and other buildings often have quantities of baling wire lying about (this is the "haywire" that caused a slipshod operation to be known as a "haywire outfit"), and some of this may still be in usable condition. It is too stiff to be used for snare nooses for any but large animals, but it is unexcelled for lashing things together or for suspending heavy objects such as counterweights or deadfalls.

You can make cord or rope from both vegetable- and animal-derived material. Some of the tree barks (inner barks in some cases, outer barks in others) that can be used in making ropes are: basswood, buckeye, cedar, cypress, elm, hawthorn, hickory, juniper, locust, mulberry, oak, Osage orange, and yew, and that from shrubs such as cliff rose, deer

brush, hazel, wild lilac, and rabbitbrush. You can also use the twining, woody stems of vines such as clematis, grape, honeysuckle, and wisteria either as cords or as cord-making material.

Fibers from the stalks of burdock, wild flax, some grasses, Indian hemp, milkweed, nettles, sunflowers, and thistles make strong to very strong cord. The whole leaves of bear grass, some species of wild iris, and various species of grass and yucca make very strong cordage; the leaves of some sedges, rushes and tules make weak cordage.

The roots of many of the woody shrubs and those of such trees as aspen, cedar, cottonwood, fir, hemlock, juniper, larch, pine, spruce, tamarack, and yew have been used by the Indians to make thread for sewing and everything from binding twine to harpoon or climbing ropes. The long roots of reeds, some sedges, and sawgrass can also be used. The strength of these will vary with both the species and growth conditions, and these factors must be considered when deciding whether or not a material is suitable for the intended purpose.

This list is not meant to be exclusive! Test any and all vegetative material at hand that looks as if it might be suitable for making cordage. To test it, twist a thin strip of the material to see if it will break when tightly twisted. Use the whole stems of materials too small to be split. If it resists breakage, lay two or three such strips (or a group of fibers) parallel to each other and twist them together for a distance of several inches. Then, leaving them tightly twisted, grip one end of all but one strand and try to withdraw that strand by pulling on its other end. This measures resistance to end slippage. A final test is to tie a knot in the center of the potential cord material and pull hard on the ends to draw the knot tight. This will test to see whether or not the cord will cut itself when tightly tied.

If the material remains strong when twisted, offers considerable resistance to end slippage, and does not cut itself when knotted tightly, then it should make good cordage or rope. Those materials that will pass one or more of these tests but not all three (sagebrush bark is a prime example) will still make good baskets or other containers, sandals or outer soles for moccasins, or weak cordage suitable for binding things together. It is also possible to treat many such materials to make them pass all of the three tests.

Many barks, roots, and vines that will not pass these tests when gathered will easily pass when boiled, steamed, or merely soaked in hot water for a time. An easy way to steam them is in the Indian firepit. An easier alternative is to coil a length of material and tie it to hold it in a coil. Place the coil on the ground and cover it with several inches of ashes or dirt and build a fire atop this mound. If you think splitting the material would be easier after steaming, use a heap of it instead of the coil. Allow the material to steam in its own juices for at least an hour, then rinse to remove the lye. This is especially effective when preparing woody barks, roots, sprouts, and vines. After this treatment, most of these materials are nearly as flexible as twine, and you can then either use them whole or split them to make pieces of suitable size.

The size of cord you should make will be determined by the materials at hand and the purpose for which the cord is intended. When flexibility, small diameter, and considerable strength are required, as for fishing lines and snares for small animals, rely on the fibers from long-fibered herbaceous plants if you have a choice. For large cords or ropes where the only requirement is strength, you can use any suitable material, no matter how bulky.

Cord making is relatively simple. With fibers of considerable length (from flax, hemp, nettles, etc.), you can hold a bundle of them by one end and roll them between the palm

of your other hand and your leg. When splicing more fibers to make the cord longer, be sure to feather or stagger the ends to make each fiber end at a different point. If there are two persons involved, you can actually make a crude spinning machine, but one person cannot operate such a contrivance. (See Figure 48.)

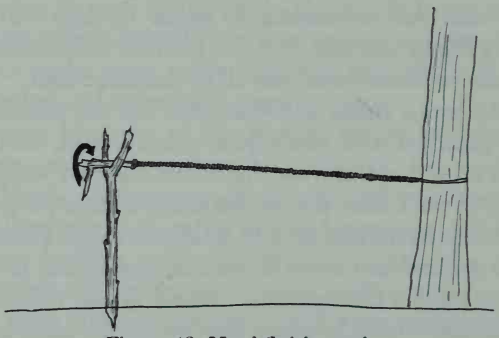

Figure 48: Hard finish crank

When the cord has been loosely twisted together in sufficient length, you can then use the pictured crank device to tighten the twist and to make a hard-finish cord. This cord will resemble a piece of commercial string or linen fishline in its surface texture. Again, however, you can make as good a cord by hand. It will just take more time and work.

To make a cord of considerably greater strength or size, or when it is necessary to use shorter materials, you must use the "Flemish twist" method. Hemp ropes, most steel cables, and a large proportion of ropes made from natural or synthetic fibers are so made. To make such a twist, divide the fibers into two or three bundles (two are easier to handle; three make stronger rope) or use two or three spun cords of the type just described. Lay these bundles or cords parallel to each other and tie them together at one end. Grasp the tied end firmly with the left hand (if right handed), with the

bundles trailing across your lap. Grasp the bundle farthest from you, roll it away from you, then bring it up and over the other two bundles. This is called the "lay" of the rope. Repeat with each of the other bundles in turn and continue in this fashion until you run out of material or the rope reaches its intended length. *Remember: twist or roll to the right or clockwise, lay to the left or counterclockwise.* (See Figure 49.)

Figure 49: Flemish twist

You can cut leather thongs (variously known as babiche, shagnappie, or whangs) in any width and in one continuous piece that is limited in length only by the size of the stock. Find the exact center of the stock in its smallest dimension and punch a small hole there. Thread one end of a piece of string or cord through this hole and tie it to a small stick to hold it securely. Stretch the string to the nearest edge and tie it to a pencil, a piece of charred wood, or a sharpened stick. Use this "compass" to mark off the largest possible circle. Trim off all excess material. Cut a starting thong of the desired width at some point on the perimeter.

Make a jig by fastening a knife, a razor blade, a piece of sharp-edged glass or rock, or a hatchet at the proper distance from a smooth knot, peg, or other improvised guide, and cut by pulling on the thong and rotating the stock. For best results, the cutting edge should be very sharp and inclined toward the cut.

Use the same technique to cut even-width strips from any other suitable material, such as car floor mats or vinyl seat

Figure 50: Whangs

covers. Any of these strips can then be plaited, braided, or twisted into ropes, but only those made of leather will be very strong. Whangs can be tied end to end with almost any kind of knot, but you can also make end-to-end splices without knotting. (See Figure 50.)

No other natural material you are likely to find can equal the strength of sinew. This is the fibrous material that transmits the force produced by animal muscles to the point of application. It is found in two basic forms: as massive, cordlike bundles known as tendons, which connect large muscles to joints of the skeleton, and as thin, sheathing layers attached to and covering large muscles. The most valuable of all sinews are those that cover the muscles surrounding the spine or backbone. These can be easily separated into individual, threadlike strands that are as long as the spine itself.

To retrieve the sinews in usable form, peel them from the underlying muscle, scrape them free of clinging flesh, then let them dry for an hour or two. You can then easily peel out the individual strands by pulling them apart. Let tendons dry more or less completely, then dampen them and gently pound them with a wooden club or hammer on a soft but firm surface such as a log or stump. This will separate the fibers, which can then be stripped out singly or in groups.

Individual strands can be used as sewing thread or to form cords, as already described. Strips containing several strands can be twisted for use as string or cord or can form one strand of a Flemish twist.

Once a sinew cord or rope has been twisted, it should be dampened and stretched between two points. You should then use a cloth or a piece of leather to rub the cord vigorously from end to end. This will heat the cord by friction, smooth it by eliminating or reducing the size of projections, and bind the separate fibers together with a gluelike substance drawn out of the sinew. Let the cord dry while stretched. If it then feels dry and stiff to the touch, rub it with tallow.

Use individual sinew strands or groups of strands for tying things together, as serving or seizing on cords or ropes, or for binding the handles on makeshift tools. When wrapped while wet, the sinew will dry almost bone hard and will shrink somewhat in drying.

The intestines of animals also make very strong cordage. Empty the contents, wash or rinse thoroughly, then scrape away both the outer and the inner membranous walls to leave only the fibrous main wall. It is often helpful to soak the split intestine in cold water for two or three days or in warm water for five or six hours before scraping, but you can get by without soaking if limited time or lack of water make this desirable. You will then have to substitute more muscle power, however.

Once you have removed the membranes, you should soak the now-fibrous intestine in a solution of wood ashes and water (hardwood ashes are much better for this purpose than those of the conifers) for four or five hours, then wash it thoroughly. You can then dry the material for later use or twist it while wet to make "catgut" cords or stings. You can either soak the dried material in water and use it the same way or separate it into individual fiber strands that can be used as with sinew. It is nearly as strong as sinew and is fully as useful.

To twist a wet section of intestine, lash one end firmly to a springy pole or stake and drive a short forked stake six

inches or so beyond the other end. Cut a crank stick and lash its end to the free end of the intestine. Lay the crank in the forked stake and spin it to twist the gut. You must use a little care to see that the material is twisted smoothly and evenly throughout its length and does not knot up or stack in some spots while remaining untwisted in others. *Do not release the crank without tying it!* The crank handle will spin like a propeller if released and is capable of inflicting injury. Allow the twisted gut to dry while fully stretched, then coat it with fat or tallow and rub it briskly with a piece of leather or cloth to soften it and make it more flexible.

The intestines of large animals can also be used as canteens, as rainproof clothing, and as containers for storing food or other material. For clothing, simply split the gut after cutting it in suitable lengths, clean as described above, and sew the strips together to make a raincoat, poncho, rainhat, etc. For other uses, you'll have to clean and prepare the intestine without splitting it, but the technique for doing so is simple and easy.

To clean an unsplit piece of intestine, dump the contents, wash thoroughly, then scrape off the outer membrane. You will then have to turn the section wrong side out to get at the inner membrane. Turn a deep cuff on one end, grip the edges of this cuff, then dip it full of water. The weight of the water will pull the longer end of the gut down through the cuff and the gut will invert itself. If water is limited, you can use sand, dirt, or small pebbles instead. Remove the inner (now the outer) membrane, and wash again, and the gut is then ready for use.

Tie one end of a section tightly, tamp it full of prepared food (rendered fat, pemmican, jerky, dried berries, etc.) and tie the other end tightly to exclude air. Hang the filled section where sunlight or heat from a fire will shrink and dry it. If you have filled it with precooked meat scraps mixed

with seasoning agents such as wild onions, smoking it will make a very respectable primitive sausage.

The bladders and the paunches or stomachs of large animals make useful containers, and you can even use a stomach as a boiling kettle! Open one end and tie off the other opening. Stretch the open end over a frame and suspend this to hold the pot directly over a bed of coals. You can also line a dug hole with it and use heated stones to boil the contents. The suspended pot will not burn through if flames are not allowed to touch it above the waterline, and a layer of cold rocks placed on the bottom will keep heated stones from burning a hole in the pit liner.

If you wish to use a paunch or stomach as a container, simply empty the contents, wash it thoroughly, remove the inner membrane, and stuff it with loose, fluffy materials that will both let it dry and hold it in shape. Preserve a bladder by washing it thoroughly, blowing it full of air, and tying off the opening to let it dry in inflated shape. The bladder will be parchmentlike when dry and will break or crack easily if not rubbed gently with tallow or fat to soften it.

Use turkey roasting bags (from your emergency kit) as suspended pots or kettles, or as pit liners. A piece of green hide or a piece of foil will serve as a pit liner, too. Peel flexible, nontoxic barks such as those from aspen, birch, cottonwood, and willow in large enough sections to fold into kettles. Steam the bark by holding the inner surface next to a fire to make it more flexible. You can often find suitable hollows in large rocks, and you can also burn and scrape depressions in fallen logs or stumps that will allow you to boil water with heated stones.

Make boiling kettles out of clay, either by rolling ropes of clay and coiling these into a pot or by lining a dug pit or a woven basket with a thick layer of clay. Smooth the interior surface with wetted hands to make the pot waterproof.

Fire the clay by building a small, hot fire in the pot itself or by slowly filling it with hot coals. Build a fire around the outside of a coiled pot or basket. The clay should be heated slowly, kept hot for several hours, then slowly cooled. If the pit liner cracks during firing, no great harm is done; you can simply force more clay into the crack and refire. With the coiled pot or lined basket (the basket will have burned away during firing), cracking will make the pot completely unusable for boiling, but you can still use it for baking or roasting.

Once again, however, nothing you can improvise or fabricate will be as good as material you can salvage from a car or plane or from materials discarded by humans. The hubcaps from many cars make splendid shallow kettles, frying pans, and Dutch oven lids, and the common tin can is famous as a "hobo kettle." Where old campfire pits or meat-poles between trees indicate a seasonal hunting camp, there is usually a garbage dump or covered garbage pit nearby. These dumps usually contain tin or aluminum food or beverage cans and other material that can be useful. Such camps often provide other useful material in the form of wire, nails, etc., and one can occasionally discover a cache of food or other camp goods. *Don't hesitate to use what you find if in desperate need!* You can always make the owner's loss good if you survive.

A clay pot set in a pit and surrounded by heated rocks or hot coals is excellent for baking or roasting, but a clay oven is even better. Make such an oven above ground by building it out of preformed bricks, by plastering rocks together with clay, or by using large ropelike coils of clay to make an oven shaped like a conical beehive. You can also dig a hole in a bank, lining this with clay or simply wetting and smoothing the interior surface if the dirt of the bank is suitable, then building a fire inside to fire the lining.

No matter how built, an oven must have a chimney hole at the back end or at the peak to enable a fire to burn briskly inside. When the fire is raked out of the oven and all openings sealed, the residual heat of the clay walls will bake bread or other baked goods almost as well as a kitchen range. If you have foil to place your loaves on, you will not have to clean your oven very carefully before use. If you have no foil or suitable substitute, you must sweep the floor of the oven carefully and then place your loaves directly on it.

It is also perfectly feasible to bake bread by coiling dough spiral fashion around a preheated, nontoxic stick an inch or more in diameter and propping this beside a fire. Ramrods were once commonly used for this. A branch stub or two left on the stick will help to secure the dough in position. This is the famous "bannock" or "stick bread" of Alaska.

If your fuel is nontoxic hardwood, you can actually bake small loaves by burying them directly in the ashes at the edge of the fire. These ashes will not cling to the loaf in any significant amount, and they will not penetrate the loaf at all. It is interesting to note that a spoonful of white hardwood ash is equivalent to a spoonful of bicarbonate of soda and can be used in place of soda when baking, cooking, or parboiling.

The Indian firepit is an excellent choice for baking or roasting foods, especially those that require long cooking times. Dig a pit, line the bottom and sides with rocks (never take these from a permanently wet area!), and then build a fire in the pit to heat the rocks. When the rocks are thoroughly heated, remove the fire and the ashes as best you can, put down a layer of nontoxic and bland-tasting vegetation (grasses or aspen, birch, cottonwood, and maple leaves are excellent choices), place the food on this, add another layer of vegetation, and cover the whole with dirt.

An alternative is to dig a pit and preheat a number of rocks in a fire built nearby, and to use these heated rocks to line the pit and cover the second layer of vegetation before piling on the dirt.

If the food is very moist and not in need of long cooking, simply leave the covered pit alone for the time you think necessary. If the food tends to be dry, pour some water through a hole or wet the vegetation layers just before covering. Either approach will create large volumes of steam within the pit. If very long cooking is required, build and maintain a fire atop the covered pit.

This device is unparalleled for cooking roots and bulbs or for tough meats. It is also splendid for shellfish and is good for steaming greens.

Cook small animals and birds in individual clay ovens. Wrap the eviscerated carcass is a blanket of wet clay or dip it several times in a thin clay "batter." You do not need to pluck or skin the animal when this method is used, unless you want or need to save the feathers or fur. The clay will penetrate the feathers or hair and, when baked and than broken off, it will take the skin with it, leaving only the cooked flesh behind. The hair or feathers will not taint or impart a flavor to the food. To cook, simply bury the clay-covered animal or bird in the ashes of your fire. You can do much the same by wrapping with foil, but you must skin or pluck the carcass before cooking. This also works splendidly for roots, bulbs, and tubers.

You can broil steaks, fish, or birds or small animals by skewering them with spits made of nontoxic wood (hundreds of people have been killed by using poisonous wood for spits), by clamping them between forks or woven basketwork grilles, by threading them on a piece of wire, or by placing them on or between heated rocks. You can also "plank" them by securing them to preheated slabs of non-

resinous and nontoxic wood and propping this next to a fire. Remember, though, that you cannot use pitchy or resinous wood for fuel when broiling or planking and that whatever fuel you do use will impart a flavor to the food, as will the type of wood used for the plank.

If you have any type of metal cooking pot with a bail (or that you can make a bail for), you can make all sorts of arrangements for holding this above a fire. Make a "dingle stick" by weighting one end of a pole, resting the pole in a forked stake, in a tripod or a bipod, or by resting it on a rock or chunk of some kind. Hang the kettle from the raised end. Support a bar in two forked stakes or in two tripods and use forked and notched dangle sticks to hold the kettle at any preferred height. You can even make a swinging crane that will let you swing the kettle on and off the fire at will.

You can make all sorts of supports for a frying pan, for a rock or metal grill, for a hubcap used for cooking or for a pot without a bail. Place two green logs parallel to each other and close enough together to support the utensil, building your fire between the logs. Place rocks in or around the fire to rest the utensil on. Best of all, in most instances, is a narrow fire trench, with the utensil resting either on the banks or in shallow niches or ledges carved into them. Place a clay pot on the ground and build a fire around it.

You can actually make a stove of flat rocks if these are available, and you can then use the top as a grill to cook foods on. This will not produce food of the quality you are accustomed to, as the food will both tend to stick and to pick up a certain amount of sand or grit. It will work, however, and is well worth trying.

Make a set of fire tongs to handle heated rocks or hot pieces of metal used as cooking gear, or simply to move burning chunks from one place to another. The crudest

form is simply a three-foot length of green stick an inch or so in diameter that is broken at the midpoint. The strands that hold the two halves together will act as a hinge, and you can pinch the hot object between the two ends. A somewhat better arrangement is to thin four inches or so at the center of a similar stick, removing the material from one side only. This will allow you to bend the stick in a **U** shape, but you must tie it in position to keep the two sides parallel to each other. You can also use a narrow forked stick, using the two branches to pinch the object. Best of all for handling heavy objects and for absolute security of grip is a set of tongs made of two forked sticks. This is a two-handed tool, but you can securely grasp anything from small rocks to large chunks of burning wood with it. (See Figure 51.)

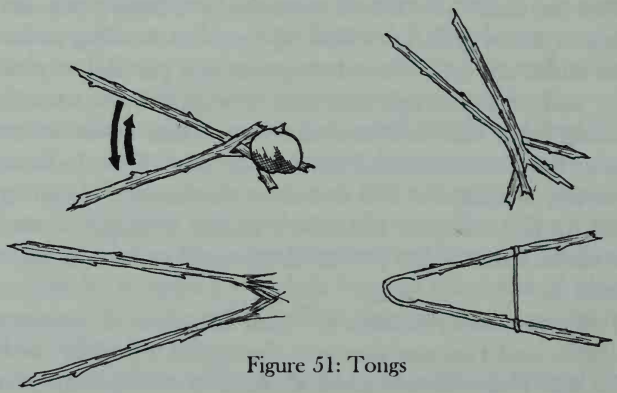

Figure 51: Tongs

Repeated reference has been made throughout this book to the use of hot rocks to heat or boil water, in cooking, to provide heat in a shelter, or as substitute heating pads or bed warmers. Most such references have been accompanied by the warning that rocks from wet areas should not be used. Rocks from saturated areas always contain some water, and

the steam generated by heating sometimes causes these rocks to explode like hand grenades. Such explosions have blinded, maimed, and even killed people who have used such rocks for fire circles, to set kettles on, or for any other use where they were subjected to intense heat. Use only rocks from areas that are free of standing or running water throughout the year.

For use as hot water bottles or bed warmers, heated rocks must be wrapped in cloth or other material, and it is often best to substitute bags of sand or dirt for these purposes. A shirt or coat sleeve or a pants leg works admirably. A bag of loose material more closely conforms to a surface and is far more comfortable than an unyielding rock.

Repeated reference has been made, too, to the use of furs or skins. For anything but immediate use, these should be dressed or tanned. This entails both time and hard work, but the results are well worth the effort. The skins are made as flexible as cloth, are protected against decay, and objectionable odors are largely eliminated.

When an animal is taken, you should skin it immediately if possible, while it is still warm. If the animal has died in a snare or deadfall and has been dead or even frozen for a time, the skinning process will be more difficult and it will be much harder to keep from cutting the skin. There is no need to "case skin" the animals, even in the case of small fur-bearers, when skinning for use rather than for sale. Instead, skin all animals by slitting the skin from chin to base of tail, slitting the inside of all four legs from the foot or ankle to the main cut, then peeling the skin off. With fur animals you will want to skin the head and open up the tail. With animals such as deer, you will want to cut the skin off where the neck and head join. The skin must then be cut off at the knees or hocks, as it is nearly impossible to skin the lower legs and that skin would be of little value.

To peel the skin from a carcass, use your knife sparingly. Use your fist to force the skin away from the flesh in larger animals, stiffened fingers with smaller ones. If you are reluctant to use your hand for these operations or if the skin is reluctant to fall away, whittle a wood "spud" with a blunt, chisel-shaped end to use instead. In some cases, you can simply pull off the skin, as with rabbits and squirrels.

Whenever possible, the animal should be suspended for the skinning operation. This permits free access to all parts of the animal, keeps both the carcass and skin free of dirt and debris, and automatically keeps the freed skin out of the way. With large animals, hang by a "gambrel" thrust through slits made at the hocks. Hang smaller animals by the hind feet or the head.

Hoist with a rope thrown across a horizontal bar or simply place the gambrel or the leg or head ties over a limb stub. You can use a set of sheer poles or a single pole to help hang a deer-sized animal from a bent sapling. (See Figure 52.)

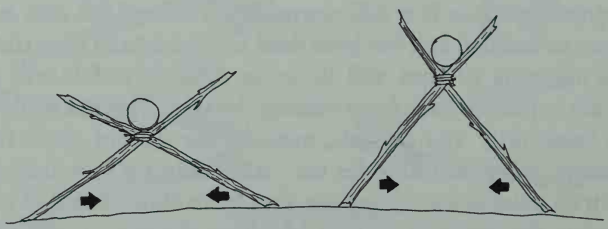

Figure 52: Sheer poles

Once the skin is off, the process of tanning or dressing should be started at once with any skin intended for use with the hair on. The first operation is to make sure that all foreign objects, such as hard mud balls, sticks, etc. are removed and that no felt-like hair balls or other lumps remain in the

hair. Wash the hair or fur and rid it of clotted blood or other matter. Any lump or bump remaining in the hair will cause a puncture of the skin during defleshing or other operations.

The second operation is defleshing of the skin. This is best accomplished while the skin is soft and pliable. Drape the skin over a peeled pole or other smooth surface. Knots or bumps on the pole will cause punctures. Scrape adhering fat and scraps of flesh away, working from tail to head end. Any dull-edged implement such as the back of a fixed-blade knife, a rib bone or shoulder blade, a hardwood spud, or even the milled edge of a coin will work for smaller skins; and the wooden and bone tools can be improved by carving blunt and shallow teeth into the scraping edge. Use these tools with a hacking, scraping motion.

For larger skins that are thicker and more durable, you should use narrow, chisel-shaped fleshing tools not more than an inch or so wide. Make one from the legbone of a deer, a hardwood limb, an antler, or from a thin rock or a fifty cent piece set into a handle. Again, the tool is much improved by whittling or grinding small, blunt teeth into the striking edge. Hang the skin tail up on the side of a smooth-barked tree or drape it over a smooth log. Once again, any bump or projection, either in the hair or on the supporting surface, will produce punctures in the hide. Hold the fleshing tool at a shallow angle to the skin and strike with a stabbing, scraping motion.

When such a skin is intended for use with the hair on, stretch it tightly immediately after fleshing and allow it to dry. In winter or in humid weather, this normally means taking it into your shelter. *Do not do so in bear country, as a fresh skin is equivalent to an engraved invitation!* In sunny weather or drier areas, the skin will dry more quickly outside. *Do not expose it to direct sunlight or high heat at this stage.*

When the skin is completely dry, you will notice a sort of glazed membrane over the inner surface. Remove this by careful use of the fleshing tool. Every trace of this membrane must be removed, as it would keep tanning fluid from entering the skin.

You must now "stake" or work the skin to open the pores and to break up the cross-linkage between fibers. You can do this in several ways. Old-time professional tanners used either a stake (a dull-edged blade with rounded corners set into the top of a post) or a crutch knife (a blunt-edged circular blade set into the tip of a crutchlike handle).

You can use a coin or several coins set into the top of a post or even a stake with a smoothly rounded tip like a broom handle to work the skin. Hang the hide over the post with the flesh side down, then drag it back and forth as vigorously as you can without tearing the skin. Work it in every direction and make sure the entire hide is worked.

With a larger skin to be tanned for leather, you must both deflesh it and dehair it. The easiest method of dehairing is to submerge the whole hide in water for several days, testing it each day by pulling on the hair. When a clump of hair pulls free with little resistance, take the hide from the water, drape it over a smooth log and scrape the hair off. An outer layer of skin (the grain) will scrape off with it. Then stretch the hide tightly and let it dry.

The hide after drying will be very stiff and harsh. This is rawhide, untanned but usable where toughness but no flexibility is required. There are several methods of softening it and opening the pores to allow the tanning solution to enter the skin. First dampen the skin, then stake it as described for furs, peg it down over a yielding pad of dry vegetation and strike it repeated, glancing blows with a club or a smooth stone hammer, or wring or twist it.

The wringing and twisting is the easiest, fastest, and most effective method. Soak the skin in water, then drape it over a crossbar lashed head-high between trees or other supports. Lap the ends and tie them securely. Thrust a crossbar through the loop thus created, then twist this bar to wring and stretch the skin. Twist first in one direction, then in the other, moving the skin loop each time to have different sections on the bars.

Once all parts of the skin have been thoroughly twisted and all excess water has been wrung from it, lash the movable crossbar in position or jam it between the rigid crossbar and upright to keep the skin tightly twisted. *It is dangerous to release the crossbar lever without securing it!* Let the skin dry until just slightly damp, then release and untwist it and treat with the tanning solution.

The tanning fluid may be rubbed into the damp skin with the hands or the skin can be soaked with the solution for several hours, perhaps overnight. Allow the treated skin to dry thoroughly, then wash with clear water and stretch it in a frame or between trees until nearly dry. Work the nearly dry skin by staking it or twisting as before. Every inch of it must be twisted or worked if it is to be soft and supple. If you run out of time and energy before the skin is completely worked, however, you can dampen the unworked areas later and work them until dry. If you think this is a lot of work, you can chew the skins as Innuit women did!

You will then have soft white leather that is suitable for any use where it will not be saturated. Wetted while in this stage, the leather will be stiff and harsh when dried and must again be worked to soften it and restore pliability. To make it remain soft after a soaking, you must smoke it.

Dig a shallow trench several feet long and roof it with sods, rocks, or dirt-covered bark. Build a firepit at one end (preferably downhill) and set up a tripod of small poles over

the other end. Build a small, hot fire in the firepit, let it burn down to a bed of coals, then smother the coals with slightly damp, well-rotted nonresinous wood. You want to produce lots of smoke, very little heat, and almost no soot.

The best woods for smoking are alder, aspen, birch, cottonwood, poplar, willow, or similar soft, deciduous hardwoods; but any nonresinous wood that has rotted to a spongy state will do. You must make sure, however, that no large knots or unrotted sections remain in the wood, as these would produce too much heat and could damage the skin. Keep a close watch on the fire and control it by opening or closing off the draft or by dampening the wood as necessary.

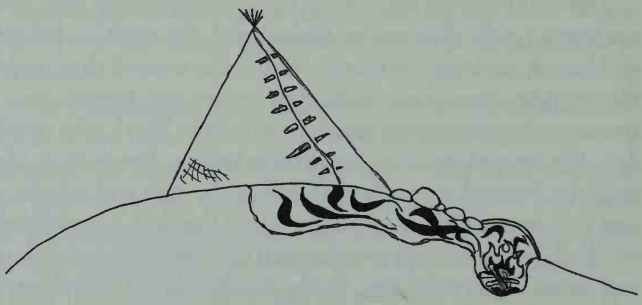

Figure 53: Smoking skins

When the fire is producing the proper smoke, drape the skin around the tripod, pinning or sewing the edges together to form a smoke-tight tepee. Weight or peg the bottom to retain the smoke. Allow to smoke for one to several hours, depending on the color wanted. Lay your palm on the outside of the skin frequently to make sure it is no more than reasonably warm. You can check for color by turning a flap

at the bottom or by lifting the whole cone off the tripod. When satisfied, turn the skin wrong side out and smoke the other side.

Remove the skin from the tripod when checking on or refueling the fire, as increased draft may cause the fire to produce too much heat. (See Figure 53.)

You now have true "Indian tanned buckskin" that is suitable for clothing, moccasins, or any other use requiring soft and pliable leather. It will stretch somewhat when wetted, but will remain soft as ever when redried. No insect or wasp can sting through it, it is perfectly comfortable when worn against the skin (when it's dry, that is!), it is completely windproof, and it provides more insulation than cloth. It feels clammy when wet, but it has almost no wicking action, and it thus continues to provide considerable insulation even when saturated. Best of all its qualities, however, is the fact that it is available where little else is and that it comes wrapped around a considerable quantity of nutritious and palatable food.

The tanning fluid or solution so often mentioned in the preceding instructions is simply a mixture of the animal's brain and water. Some Indians added liver and fat, while others used equal parts of brain and fat, but this is not necessary with deer skins. With heavier skins such as those of elk or moose, where treatment must be repeated, fat should be used to supplement the brain.

To prepare the solution, remove the brain from the skull and immerse it in a quart or so of very warm water. Work the brain with the fingers, reducing it to a pulp that mixes readily with the water to form a slurry. Remove any bone fragments during this process. When the brain and water are of uniform consistency, simmer the solution gently for an hour or so, then allow it to cool to approximate body temperature. A small deer should produce about one quart of

solution, a large deer about one and a half quarts. Rub the warm solution into the prepared skin.

If you must store the solution for later use, as when tanning a skin without the hair, the best method is to freeze it if the weather permits. If the weather is too warm for this, simmer it to a jellylike state and store this in a section of intestine. An Indian method was to blot the solution up in bunches of tree moss or dried grass, dry these, and store them in a cool place until needed. The moss or grass was then heated in water and the liquid poured off. You can also slice the whole brain thinly and dry it for later use. Do not neglect such preservation, as decomposing brain tissue has to be smelled to be believed!

Remember, both skin and brain are edible, both to you and to animals, birds, and insects. You must therefore take all possible steps to protect both skin and brain from predation while processing.

Boil a piece of hide with the hair removed to the point of disintegration in a small quantity of water to produce glue. Boil the hooves and the foot and ankle bones of ungulates for one or two hours in a small amount of water to produce neat's-foot oil, which is unexcelled for softening or restoring leather. Render fat or tallow for use as cooking lard or for making pemmican.

Hair removed from skins is valuable as insulation or padding, and you can use bones and antlers to make tools or weapons. Even the soup left after neat's-foot oil has been skimmed off and the cracklings left after fat is rendered are useful, either as food in the one case or as bait in the other. Be like the commercial butcher who "uses every part of a pig but the squeal," or like the Indians, who used almost every part of the buffalo for something. The uses of animal parts are limited only by your imagination and your willingness to experiment.

Weaving was one of the earliest and most valuable crafts practiced by man, and a knowledge of the basic techniques involved is of real value to anyone who must take advantage of every available resource to survive under primitive conditions. When weaving is practiced for the making of useful rather than decorative articles, the technique involved is relatively simple and easy to learn.

The simplest form of weaving is designed to produce flat mats suitable for walls, floors, or other structural parts of a shelter, or for making clothing, blankets, hammocks, etc. This weaving requires a number of "warp" strands laid parallel to each other at more or less regular intervals, and a number of "woof" strands laid at right angles to the warps. The first woof is laid over the first warp, under the second, over the third, and so on. The second woof then lies under the first warp, over the second, and under the third.

Tie the warp pieces between two horizontal or vertical bars and weave the woofs into them. This can be done by hand with thick, wide material, or with a shuttle in the case of thinner and more flexible material. You can also make a mechanical loom and eliminate much of the tedious work involved. (See Figure 54.)

Tie all of the warp strands to a fixed horizontal bar tied at waist level between two trees. Tie the other end of every

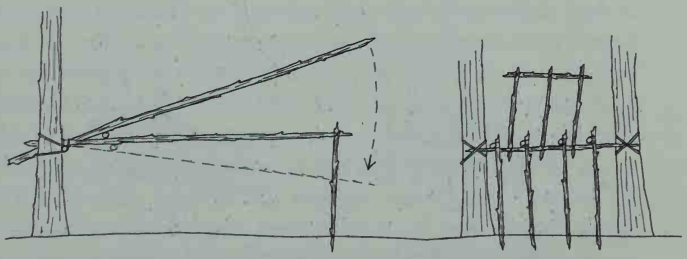

Figure 54: Loom

other one of these at the same height to vertical stakes set at the opposite end of the loom. The alternate and slightly longer strands are tied to a movable horizontal bar just past these stakes. This bar can be raised and lowered at will, with the attached warps moving up and down between the stakes.

In operation, this bar is lowered and the first woof piece is simply passed between the lowered and the fixed warps. The bar is then raised and the next woof is placed between the raised and the fixed warps. It then only remains to force the two woofs together and to continue this process until the mat is completed.

Anything even reasonably flexible is grist for the weaver's mill under survival conditions. Use evergreen boughs, deciduous branches, cattails, fern fronds, tules, reeds, grasses or sedges, strips of bark, or almost any other such material for the woofs, and you can use these or even stiff, rigid sticks for the warps, lashing them at each end with other material.

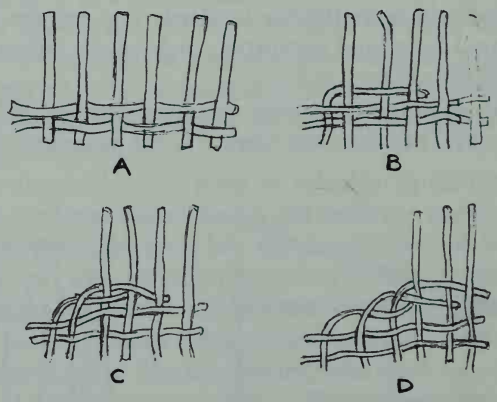

Figure 55: Basket rims. Cut each splint with the stub outside. Seize or wrap with finer material if desired.

Basket-making involves the same basic technique, but the warp is usually formed of more or less rigid pieces with more flexible woofs woven into them. The usual method is to have warps long enough to reach clear down both sides and across the bottom, with an excess projecting above the rims; but it is perfectly feasible to splice the warps by overlapping two pieces for several inches, allowing the woofs to hold them in position. The woofs, too, can be spliced by overlapping. The basket rims can be formed by several different methods. (See Figure 55.)

This concludes the informative part of this book. I have tried to pass on to you, the reader, those bits of knowledge of survival and outdoor lore that I have acquired over a considerable span of life. If some of this seems to have been carried to the point of tedium, I make no apology.

No single person could possibly have need of all this information, but some particular item might be absolutely vital to someone at some time, and no one can foretell which item it might be. It is certainly better to have the knowledge and never need it than to need it and not have it. Many readers will also discover that each tidbit of knowledge gained and each outdoor skill learned will enhance their enjoyment of their outdoor pursuits. This has certainly been true for me.

It may become automatic for you to catalogue the resources available in any area you find yourself in and to plan the course of action you would take if you were forced to depend upon those resources for survival. It may also become your habit to collect and use those wild plants and plant products that interest you, and you may find real satisfaction in using the parts of the animals you take to make jerky, leather, pemmican, sausage, tools, etc. Practice in such skills will improve your chances of surviving in a real emergency and will afford you considerable pleasure as well.

In the final analysis, however, survival does not depend solely upon knowledge, practice, or acquired skills, although each will make survival easier. Survival, instead, depends primarily upon attitude and applied ingenuity.

One person will perish with every resource needed for survival and even comfort readily available, even in marginally severe conditions. He panics, fails to recognize the emergency until too late, or simply fails to correctly evaluate the situation and take the necessary steps to cope with it.

Another person, lacking even the minimal equipment normally required for survival, will come out of the most extreme situations without any ill effects. He will have diagnosed the emergency quickly and correctly, will have evaluated the risks and the benefits of the options open to him, and will have chosen those offering the most benefit with the least risk and effort. He will have used the best survival equipment of all: common sense.

Whether or not you will survive an emergency situation at all, and whether you will do so in relative comfort or abject misery, is thus largely dependent upon your attitude and common sense. I trust that you will survive if faced with such an emergency, and I hope that this book will help you do so in comfort. In any case, you will decide the outcome. Good luck!

(continued from the front flap)

- build a fire and keep it going;
- construct a weatherproofed shelter out of available materials;
- find and prepare food and water;
- avoid hypothermia and dehydration;
- deal with severe distress signals;
- make basic workable tools.

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It encourages you to experiment in your back yard and make each and every trip into the field an imaginary survival test.

Your life is important only to you in a survival situation and you alone will decide by the actions you take how well you will live.

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Bob Harris

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